THE ORAL HEALTH OF CHILDREN IN THE DISTRICT OF DILI, TIMOR-LESTE

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Declaration of Originality

I, Lucio Frederico Babo Soares, am the author of the thesis titled *The Oral Health of Children in the District of Dili, Timor-Leste,* submitted for the degree of Doctor of Philosophy. I declared that the material is original, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright. The thesis contains no material which has been accepted for a degree or diploma by the University or any other institution.

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Statement of Authorship

This thesis includes papers for which Lucio Babo Soares (LBS) was not the sole author. LBS was the lead in this research as he completed the data collection, analysed the data and wrote manuscripts. However, he was assisted by the co-authors whose contribution are detailed below.

The Paper Reported in Chapter 4

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The contribution of each author:

LBS was responsible for obtaining approvals, assisted with design and planning of the survey, undertook the data collection and assisted with the write up of the paper.

PA undertook analysis and interpretation of the data, assisted with the write up of the paper, completed revisions, and was the submitting and contact author of the paper.

JK assisted with the write up of the paper.

KRT helped with the baseline survey and report, contributed to the survey questionnaires and plan, and assisted with the write up of the paper.

SB assisted with the write up and oversaw parts of the project.

LC oversaw the project and paper

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Abstract

Introduction

The health situation of Timor-Leste was particularly poor during both Portuguese colonial administration and Indonesian occupation. There was no national oral health policy or strategy during the four and a half centuries of Portuguese colonisation or the 24 years of Indonesian occupation. The country health profile in 2002 showed that life expectancy ranged from 50-58 years, and was combined with high infant mortality rates of 78-149 per 1,000 live births, and under-5 year mortality rates of 124-201 per 1,000 live births. The 2002 Timor-Leste National Oral Health Survey found that 85% of children and adults had never made a dental visit. Some visits were made to dentists, dental nurses and general medical practitioners, but nearly half were made to other providers such as traditional healers. The burden of dental caries was found to be low to moderate in children and adults, likely linked to a subsistence farming low-sugar diet. However, dental caries was mostly untreated, or treated by extractions, often not performed by dentists or dental nurses.

Methods

An epidemiological survey was conducted to investigate the oral health status of children living in Dili in 2014 and to compare the results with the 2002 data. The survey was informed by the methods of the 2002 AusAID supported National Oral Health Survey. Four subdistricts from the six sub-districts in the Dili district were randomly selected for inclusion. A total of 40 randomly-selected schools were invited to participate: 18 in Dom Aleixo, 12 in Cristo Rei, seven in Vera Cruz and three schools in Metinaro subdistrict. Students aged 6-17 years enrolled in primary schools, and in junior and senior high schools in the district of Dili were then randomly selected from four age groups (6-8 years, 9-11 years, 12-14 years and 15-17 years) and invited to participate in the survey.

The sample size required for the 2014 survey was calculated based on a hypothesised 25% increase (from 2002 level) in the prevalence of dental caries in the permanent

dentition. As the 2002 survey recruited 201 children from Dili, a sample of 600 children for the 2014 group would result in >80% power at alpha level 0.05 for the investigation of the prevalence of decay in permanent teeth in 2014 compared to 2002.

Prior to an oral examination, and after written informed consent was obtained, a questionnaire was handed to participants' parents or carers, or to children who were aged 15-17 years. The questionnaire collected data on demographics and oral health behaviours, dental visits and the treatments received. After completing the questionnaire, participants took part in an oral examination conducted by four dentists and five dental nurses who had completed training in the standardised oral health assessment methodology. Children's dental caries experience was scored using the decayed, missing and filled teeth index for both deciduous teeth (dmft) and permanent teeth (DMFT) and the oral examination also included information on gingival bleeding and the presence of calculus.

A review of Timor-Leste oral health policy documents was conducted. Scoping interviews were undertaken to identify the extent to which the recommendations of the 2002 National Oral Health Survey (NOHS) had been implemented, and if not, to seek the perceptions of stakeholders as to why the recommendations were not implemented.

Health and oral health policy makers, dental clinicians and academics based in Timor-Leste were recruited to take part in scoping interviews. The interview was based on three open-ended questions designed to collect information on the implementation or otherwise of oral health policy recommendations made in the 2002 National Oral Health Survey report.

Results

There were 758 participants in the oral health questionnaire and 655 children participated in the oral examination. There were 388 boys (51.2%) and 370 girls (48.8%) who completed the questionnaire. Nearly all children (96.7%) reported that they brushed their teeth the previous day, although 36.8% suffered from toothache (sometimes to very often) during the previous 12 months and 33.3% reported being

unhappy about the appearance of their teeth. Under a quarter (23.8%) of the children had visited a dentist in the previous 12 months and 44.6% had ever visited a dentist.

The oral examination found most of the children exhibited gingival bleeding (64.6%) and calculus (57.1%). Mean dmft+DMFT was 3.5. Primary dentition dental caries was present in 83.3% of the children and the mean number of primary teeth decayed (d) teeth was highest in children aged 6-8 years at 4.7. The mean number of decayed, missing or filled primary teeth was 5.1 in 6-8 years old and 2.2 among 11-12 year olds while the mean number of decayed, missing or filled permanent teeth was 2.9 in 12-14 years old and 3.4 among 15-17 year olds. Compared to children aged 6-8 years, children in the other age groups had significantly lower mean dmft+DMFT.

Comparison of the 2014 and 2002 survey data found that in 2014, a lower proportion of children reported brushing their teeth the previous day (96.7% vs. 100%, $p = 0.01$) and a larger proportion reported suffering from toothache (40.2% vs. 19.2%, $p < 0.001$) (sometimes to very often) during the last 12 months. The mean number of decayed, missing or filled teeth in the primary plus permanent dentition (dmft + DMFT) was greater in 2014 than in 2002 (4.24 vs. 3.53, $p = 0.01$). There was no difference in the prevalence of decay in the primary dentition (38.8% vs. 36.8%, $p = 0.61$) or the mean number of decayed, missing or filled (dmft) teeth in the primary dentition in 2014 compared to 2002 (1.99 vs. 1.80, $p = 0.47$). However, the prevalence of decay in the permanent dentition was greater in 2014 (69.8% vs. 53.4%, $p < 0.001$) as was the mean number of decayed, missing or filled in the permanent dentition (DMFT) (2.26 vs. 1.73, $p = 0.006$). The prevalence of gingival bleeding (64.6% vs. 81.0%, $p < 0.001$) and calculus (57.1% vs. 85.8%, $p < 0.001$) was lower in 2014.

Prevalence of untreated tooth decay in the primary teeth (d) of the children was not associated with the education level of their parents (38.8%, 38.8%, $p = 0.96$), though there was a significantly lower prevalence of untreated tooth decay in the permanent teeth of children of parents with a senior high school or above level of education than in children of parents who had no or low level parental education (67.0 vs. 71.3, $p = 0.03$).

Primary dental caries experience (dmft) was greater in children from mid-high socio-economic (SES) schools than in children from low SES schools (2.15 vs.1.12, $p = 0.001$), but there was not a significant difference in DMFT or overall dental caries

experience (dmft+DMFT) between children of low and mid-high SES schools. Children who had visited a dentist during the past 12 months had greater dmft than children who had not (2.70 vs. 1.75, $p = 0.005$) and children who had suffered from toothache sometimes to very often had a higher dmft than those who had suffered from toothache never or hardly ever (2.30 vs. 1.67, $p = 0.02$).

The analysis of oral health policy documents and interviews with stakeholders found few of the recommendations from the 2002 National Oral Health Survey report had been implemented, owing to (i) lack of local support for the recommendations, particularly on promotion of oral health; (ii) lack of financial and budgetary provisions for oral health; (iii) lack of focus on services, human resources and dental personnel; (iv) poor focus, design and implementation of policy and planning in oral health; and (v) lack of transport to facilitate health-care workers' access to remote areas.

The thesis recommended to the Timor-Leste Government that key priorities for oral health policy in Timor-Leste are promotion of oral health, legislative interventions, education of the oral-health workforce, dental outreach programmes, targeted dental treatment, dental infrastructure programmes and research and evaluation. Interventions include promotion of oral health for schoolchildren, salt fluoridation, fluoride toothpaste and banning sweet stalls and use of tobacco and betel nut in, or near, schools. Timor-Leste should strengthen the availability and quality of outreach programmes for oral health. Dental therapists and dental nurses who can supply preventive and atraumatic restorative dental care should continue to be trained, and the planned dentistry school should be established. Ongoing research and evaluation is needed to ensure that the approach being used in Timor-Leste is leading to improved outcomes in oral health.

Conclusions

More than half of the children had never visited a dentist, there was a low number of filled deciduous and permanent teeth, and untreated dental caries was highly prevalent. indicating a high level of unmet need for dental care among Dili's school children.

There was greater dental caries experience in Dili school children in 2014 than 2002, associated with a greater permanent teeth dental caries experience.

Primary dental caries experience in 2014 was greater among children from mid-high SES schools than from low SES schools.

The untreated dental caries prevalence was greater in the children with parents with higher education levels than for children with parents with lower education levels.

Few of the recommendations from the 2002 National Oral Health Survey report had been implemented. Copying the medical model to improve oral health is not feasible in a developing country with a rapidly growing population, as found in Timor-Leste. Key priorities for oral health policy in Timor-Leste are promotion of oral health, legislative interventions, education of the oral-health workforce, dental outreach programmes, targeted dental treatment, dental infrastructure programmes and research and evaluation.

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List of Abbreviations

ABRI	Angkatan Bersenjata Republik Indonesia (or Indonesian National Army)
ART	Atraumatic Restorative Treatment
BSP	Basic Service Package
CIA	Central Intelligence Agency
CPI	Community Periodontal Index
dmft	decayed, missing, filled teeth (for primary dentition)
DMFT	Decayed, Missing, Filled Teeth (for permanent dentition)
DDDP	Dili District Development Plan
DoH	Department of Oral Health
DRSU	Dental Statistics Research Unit
GOLT	Government of Timor-Leste
GNI	Gross National Income
HERC	Human Research Ethics Committee
HDI	Human Development Index
HNGV	Hospital Nasional Guido Valadares (or Guido Valadares National Hospital)
HSP	Hospital Service Package
IDP	Internally Displaced Person
IHA	Interim Health Administration

INTERFET	International Force for East Timor
JAM	Joint Assessment Mission
MDGs	Millennium Development Goals
MoH	Ministry of Health
MSG	Mother Support Group
NGO	Non-Government Organisation
NHANES	National Health and Nutrition Examination Survey
NHPF	National Health Policy Framework
NOHS-TL	National Oral Health Strategy for Timor-Leste
NSD	National Statistics Directorate
OHRQoL	Oral Health Related Quality of Life
OHSPP	Oral Health Strategic Plan and Policy
OUT	Oral Urgent Treatment
PEM	Protein Energy Malnutrition
PHC	Primary Health Care
PTA	Parent Teacher Association
RCT	Randomized Control Trial
SES	Socio-Economic Status
SISCA	Servico Intergrado da Saude Comunitaria (or Integrated Community Health Services)
TLDHS	Timor-Leste Demographic and Health Survey
TL-NOHS	Timor-Leste National Oral Health Survey

UNAMET	United Nations Administration Mission for East Timor
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Program
UN-PKF	United Nations-Peace Keeping Force
UN-MGDAF	United Nations-Millennium Development Goals Achievement Fund
UNTL	Universidade Nasional de Timor-Leste (or National University of Timor-Leste)
UN-WFP	United Nations-World Food Program
WHO	World Health Organisation

Publications Directly Arising from the Work Described in This Thesis

Babo Soares L, Allen P, Kingi J, Roberts-Thomson K, Bettiol S, Crocombe L. Changes in the oral health of the children of Dili, Timor-Leste, between 2002 and 2014. *Proceedings of the Rural Health Research Symposium-University of Tasmania*, 26-27 April 2016, Burnie, Tasmania. 2016. [Abstract]

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Babo Soares L, Steven S, Crocombe L, Macintyre K. Oral Health in Timor-Leste. *Proceeding of the First Southern Meet of Australian Dental Association (ADA) Tasmanian Branch*, 19 February 2013, Hobart, Tasmania. [Abstract]

Babo Soares L, Crocombe L, Steven S. Oral Health in Timor-Leste (East Timor): Working together to find solution. *Proceeding of the Meet of Australian Dental Association (ADA) Tasmanian Branch*, August 2014, Launceston, Tasmania. University Department of Rural Health (UDRH) Bulletin; July 2013. Available from: *http://www.utas.edu.au/data/assets/pdf_file/0007/417517/udrh-bulletin-2013-jul-updated.pdf* [Abstract]

Babo Soares L, Crocombe L, Steven S. BOA TARDE ‘Good afternoon in Timor-Leste’. *Australian Association for Academic Primary Care Inc (AAAPC) Newsletter*; April 2014: 7(3): 10-12. [Abstract]

Conference Presentations Using the Work Described in This Thesis

Babo Soares LF, Steven S, Crocombe L, Macintyre K. Oral Health in Timor-Leste. Presented at the First Southern Meet of Australian Dental Association (ADA) Tasmanian Branch, 19 February 2013, University Club - Sandy Bay Campus, Hobart, Tasmania. Oral and Slides Presentation.

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Babo Soares LF, Steven S, Crocombe L, Macintyre K. Timor-Leste Oral Health in Timor-Leste (East Timor): Working together to find solution. Presented at Eat & Meet of Australian Dental Association (ADA) Tasmanian Branch, August 2013, Launceston, Tasmania. Slides and Oral Presentation.

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Crocombe L, **Babo Soares LF**, Bettiol S, Dalla-Fontana I, Allen P. Oral Health Policy Opportunities for Timor-Leste. Presented at Primary Health Care Conference at the National Convention, Canberra. 8-9 June 2016. Poster and Oral Presentation.

Chapter 1

Background

1.1 Introduction

The history of Timor-Leste has played an important role in the health sector. The health situation during the Portuguese colonization era and the Indonesian occupation period and since the country declared its independence (2002) is reviewed.

This review will focus on six major topics: the history and the health context of Timor-Leste, dental caries and gingival conditions, and their population measurements, dental caries experience of children in developing countries, the oral health situation in developed and developing countries, factors influencing dental caries and the caries experience of children, methodologies used in the dental survey and a conceptual model of development is proposed. The literature discussed in this chapter will focus on the dental caries prevalence and experience in the deciduous and permanent dentition of children age 6-17 years old in countries of similar socio-economic status (SES) as Timor-Leste.

1.2 Literature Search Methods

Information relating to the dental health status of children provided in this thesis was extracted from scientific articles published between 1942 and 2016. They were searched by using ProQuest, Medlinevia PubMed, the Cochrane Library and the University of Tasmania Library MegaSearch databases. Dental subject heading (dental caries prevalence or experience) search terms were used as appropriate for all databases. Data on the prevalence of dental caries and the dmft/DMFT scores of children were extracted from the articles. About 360 articles were screened, and of these, 254 papers were selected for this thesis.

1.3 The History of Timor-Leste

The Democratic Republic of Timor-Leste (East Timor) is a half island country with a total area of 144,610 sq. kilometres located in the eastern part of Timor Island in Southeast Asia. Administratively the country has 13 districts, 65 sub-districts, 442 sucos (villages) and 2,225 settlements. About one third of its population lives in remote areas, in rural districts and sub-districts isolated by mountains and poor roads (MOH-TL 2011). Timor-Leste's closest neighbours are Australia and Indonesia.

Timor-Leste was first colonized by the Portuguese in 1520. The Dutch, who claimed many of the surrounding islands, took control of the western portion of the island in 1613. Portugal and the Dutch signed a treaty in 1860 which granted the Portuguese the eastern half of the island including the western enclave of Oecusse, while the Dutch occupied the western half of the island which is now part of the Republic of Indonesia (*NSD*, 2010). Australia and Japan fought on the island during World War II and nearly 50,000 East Timorese died during the subsequent Japanese occupation. When the Japanese were defeated, Portuguese colonisation returned and remained until 1975. During the years of Portuguese colonization there were many conflicts between local groups and the colonial rulers.

After the sudden Portuguese withdrawal the country declared its independence on the 28th of November 1975. Despite this declaration Indonesia invaded Timor-Leste on the 7th of December 1975 and annexed it. The tiny country was turned into the 27th province of Indonesia. Economic difficulties, political conflicts and war contributed to the collapse of infrastructure and service delivery throughout the country. During Indonesia's occupation, the local workforce had very limited exposure to management roles and essential skills (TL-NOHS 2004). The East Timorese suffered gross human right violations that included random massacres, starvation, torture, forced migration, and systemic raping of women as a form of ethnic cleansing. Substantial Timor-Leste resources were transferred from development in the territory to funding the Indonesian forces and to senior officials in administration (Mason 2005, Beck and Araujo 2013, *UNESCO 2009*). During the Indonesian occupation, an estimated 102,800 people suffered conflict-related deaths due to killing, hunger and illness (UNESCO 2009).

Development was not the main priority for the Indonesian colonial administration in East Timor. The human development index (HDI) is a composite statistic of life

expectancy, education, and per capita income indicators, which is used to rank countries into four tiers of human development. Timor-Leste had an HDI index of just 0.395 in 1999, placing the Timor-Leste 152nd out of the 162 countries for which HDIs were calculated (Rosser 2013). The country's development indicators showed that maternal mortality rates were extremely high. An assessment by the United Nations Development Program (UNDP) found that approximately 420 women died for every 100,000 live births (UNDP 2002). Poverty was high with 41% of the population living below the poverty line of US$0.55 per person per day and about 50% of Timorese were illiterate (UNDP 2002). Poverty was more common in the rural areas (46%) than in the urban centres (26%), with the lowest poverty rate being in the urban centres of Dili and Baucau (14%) (NDP 2002). The situation did not improve over the following five years. In 2007 nearly 50 percent of Timorese were living below the national poverty line, estimated at $0.88 per capita per day (Survey of Living Standards, 2007).

In an UN-sponsored referendum on the 30th August 1999, the East Timorese voted for independence from Indonesia with a resounding 78.5 percent majority in a United Nations-backed referendum (World Bank 2002: 1). In a violent aftermath, pro-Indonesia militia groups backed by elements in the Indonesian army wreaked havoc on the nascent country, with some three-quarters of the population displaced. The anti-independence militias undertook a punitive "scorched-earth" campaign during which the 70 percent of the country's infrastructure was destroyed, including homes, the irrigation and water supply system, schools and nearly the entire country's electrical grid (World Bank 2002: 1; Tulloch et al. 2003: 5). The militias killed approximately 1,400 Timorese and forcibly pushed 300,000 people into West Timor as refugees (CIA 2010). On the 15th September 1999, the UN Security Council authorised a multi-country peace enforcement mission in East Timor.

The peace keeping force (INTERFET: the International Force for East Timor) led by Australia was deployed in the country to restore peace and security and to facilitate humanitarian relief efforts (Rosser 2013). Shortly after the arrival of the peace keeping force, a mission of experts called Joint Assessment Mission (JAM) established by the United Nations visited the country to examine security and identify short-term relief, long-term development requirements and reconstruction priorities. The team of experts found that there was a severe collapse of the water and sanitation system, population

displacement, food insecurity and severe psycho-social stress (Rosser 2013). East Timor was internationally recognized as an independent country on 20th May, 2002, and the country became officially known as the Democratic Republic of Timor-Leste. The independence of the nation in 2002 drew a final line under more than 450 years of foreign occupation.

1.4 The District of Dili

Dili district is the capital of Timor-Leste. In 2003 it had a population of 137,879 persons, representing approximately 18% of the country's total population. In 2010 the population of Dili had increased by nearly 70% to 234,331 people. This was due to a huge influx of people from other districts to Dili (NSD 2011; UNFPA 2011). By 2010 more than half the population was aged under 20 years old, with a relatively even gender balance of 50.3% males and 49.70% females (NSD 2011; UNFPA 2011).

Dili is the primary trading and commercial centre of Timor-Leste. The district is comprised of six sub-districts of varying populations and geographic sizes (Dom Aleixo, Vera Cruz, Nain Feto, Cristo Rei, Metinaro and Atauro) and 48 villages (NSD 2011; UNFPA 2011). Dom Aleixo is the largest and the densest of the subdistricts. It covers an area of 33.12 km^2 with a population of 105,154, while Atauro covers 105km^2 and has a population of only 800(NSD 2011; UNFPA 2011).

In the Dili district the majority of people are employed in small businesses, followed by the public sector. Most people who live in urban areas such as in Dom Aleixo, Nain Feto, Vera Cruz and the west part of Cristo Rei depend for their daily consumption on foodstuffs sold in local supermarkets and traditional markets (places where people sell or purchase locally produced foods, goods and services). By contrast, people in rural Dili depend on household produced food crops and livestock. Fishing and farming are the main source of activities of people living along the coastal areas of Cristo Rei and in the subdistricts of Metinaro and Atauro. Most commodities, including refined foods, are imported from Australia, Singapore, Indonesia and other neighbouring countries (DDDP 2003).

Approximately 80% of East Timorese business people are involved in small trading and retail businesses, and the majority of these businesses are family owned and do not

employ people apart from family members. Manufacturing represents only 4% of current Timor-Leste economic output (DDDP 2003).

In Dili district, access to dental professionals, is very limited, although still higher compared to other districts. Oral health services in Dili are provided by the national government in dental clinics located in Guido Valadares National Hospital, at and in six community health centres at subdistrict level, i.e. Dom Aleixo, Nain Feto, Vera Cruz, Nain Feto, Metinaro and Atauro. The majority of dental professionals in the district are employed by the government. Dentists are employed in the national hospital, while a dentist and one or two dental nurses are placed in the community health centres of each of the subdistricts with limited access to dental materials, for instance: filling materials, gauzes, cotton pellets, local anaesthetic, and dental equipment such as dental units, dental X-ray units, autoclaves, extraction and filling materials, needles. The limited number of dentists and nurses in the sub-districts, and limited access to oral health information, lack of health education and low frequency of dental visiting has a great impact on the oral health status of the children in the Dili district.

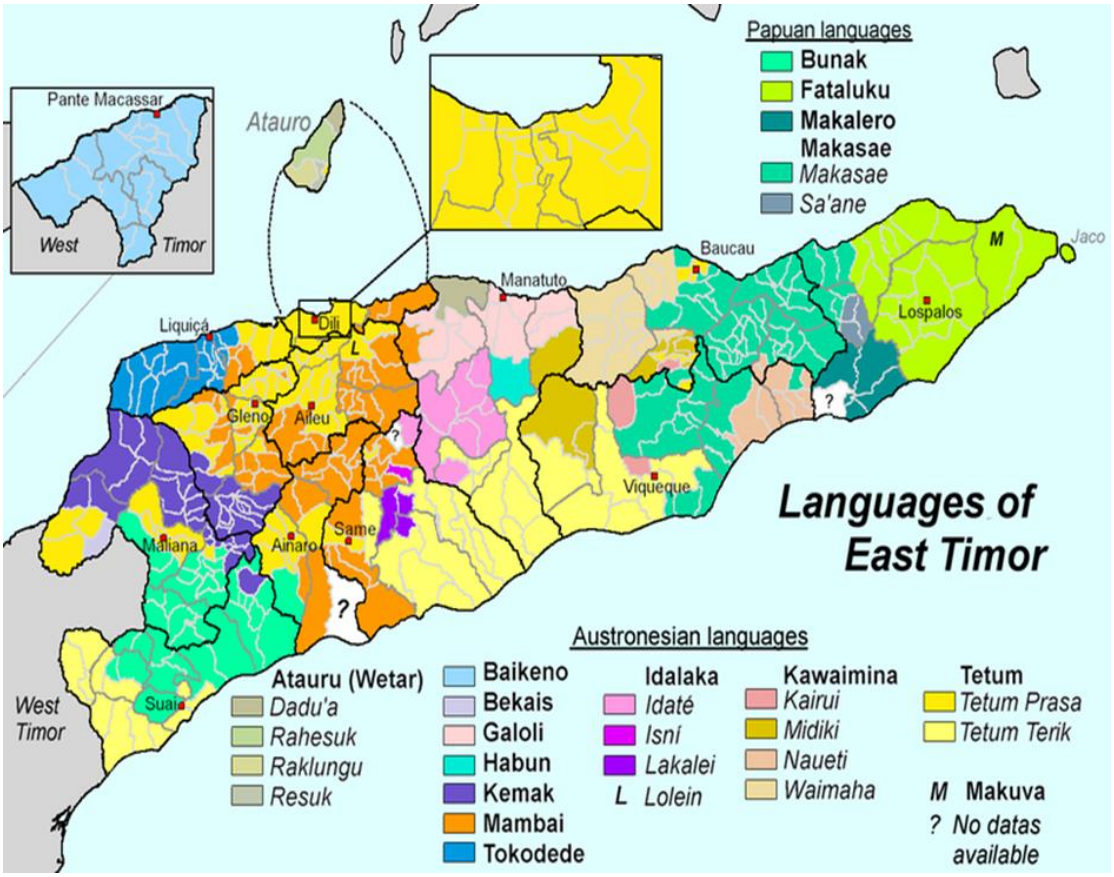
1.5 Education System

The education system under Indonesian occupation was organised in the form of primary education (six years), pre-secondary education (three years) and secondary education (three years). After gaining its independence, the education system was changed to compulsory basic education consisting of the first nine years of schooling followed by three years of secondary education. This transition is still underway and is expected to be fully implemented by the end of 2020 (TL-SDP 2011).

Post-independence rapid population growth has created significant challenges to the education sector, particularly in the Dili district, where large increases in enrolments are expected over the next decades. Only 11 % of East Timorese children aged 3 to 6 years old currently attend pre-school. In 1999, there were 3,835 children attending pre-school education (TL-SDP 2011). Whereas, the number of children enrolled in the secondary education in 2010 was 40,781 (TL-SDP 2011). Only 37.5% of Timorese schoolchildren are at the official age when entering the first grade. This means that 62.5% of the pupils start school either younger or older than the official school age,

with 26.0% one to two years older, 8.6% three years older and above, and 26.8% younger (TL-SDP 2011).

Figure 1.1. Map of Timor-Leste



1.6 Timor-Leste Health Context

The health situation of Timor-Leste was particularly poor during both Portuguese colonial administration and Indonesian occupation. Throughout these eras, positions of administrative authority and skill were almost wholly filled by foreigners, and after both these violent transitions – 1975 and 1999 – Timor-Leste was devastated by the exodus of foreign doctors and skilled health management staff (World Bank 2002; Tulloch et al. 2003). This presumably also included its dental practitioners. These periods of foreign administration hindered Timor-Leste's development of indigenous skills with which to rebuild the devastated health system, and to redress a history of neglect for the wellbeing of the East Timorese people.

During Indonesian occupation period, the health system was centrally administrated. The health system comprised of government-run hospitals at district level, community health centres at sub-district level and health posts at suco (village) level. These services were delivered by approximately one hundred doctors and two thousand nurses and midwives (Rosser 2013). Most of these health workers were Indonesian.

As a result of the 1999 unrest, over a third (35%) of all health facilities left by the Indonesian administration were totally destroyed, and most of the remaining facilities sustained severe damage. An assessment carried out in January 2000 found that 70% of the country's health facilities were targeted by the militias resulting in the looting and destruction of essential medical equipment and supplies (Morris 2001; Tulloch et al. 2003). However, the major hospitals in Dili and the district hospital of Bacau escaped largely unscathed (Tulloch et al. 2003). Most of the health workers and many senior health administrators left the country (Word Bank 1999).

Early efforts to meet the immediate health needs of the territory relied on the coordination of remaining resources and international non-governmental organisations, directed by a group of 16 senior East Timorese health professionals and a smaller group of UNTAET staff (Tulloch et al. 2003). Critical shortcomings in transportation were identified hindering the provision of services to rural and isolated communities. A strategic decision was made by the Interim Health Administration (IHA) to shape a new health system centred on a smaller number of fixed facilities than under the Indonesian administration, consolidating these services and meeting population access needs with travelling nurse clinics in some areas (Tulloch et al. 2003: 10). A community health centre would service each of the territory's subdistricts, of which there are 65, with the number of hospitals across Timor-Leste reduced; in all, the total fixed facilities envisioned by the interim administration would number fewer than half of those that existed under the Indonesian administration (Tulloch et al. 2003: 12-13; World Bank 2008).

Pneumonia and diarrhoea in children were the leading causes of death across the entire population in 1997-1998 (World Bank 2002: viii-ix; Tulloch et al. 2003: 7). The life expectancy in the territory was 52 years in 1996, ten years fewer than in Indonesia as a whole, and the incidence of poverty in 2001 was estimated as 41 percent (World Bank 2002: 1). In the post-referendum period, infant and maternal mortality rates were

extremely high and tuberculosis and malaria were highly prevalent (World Bank 2002; Tulloch et al. 2003).

As of August 2000, with the departure of Indonesian health staff, the combined number of doctors and dentists in Timor-Leste numbered 15, while the total number of nurses, midwives and other auxiliary health staff more than 1800 (Tulloch et al. 2003). With the gradual return of those that fled to West Timor due to the turmoil that followed the referendum, the population of Timor-Leste in this period was close to 800,000 (Tulloch et al. 2003).

The country health profile in 2002 showed that life expectancy ranged from 50-58, and was combined with high infant mortality rates of 78-149 per 1,000 live births, and under-5 year's mortality rates of 124-201 per 1,000 live births. Women bore an unacceptable burden of maternal mortality and morbidity, with maternal mortality rates at 350-800 per 100,000 live births (NDP 2002). Poverty and limited access to health information and health services in Timor-Leste contributed to maternal mortality and morbidity rate. Children continued to die from common diseases such as respiratory infection, malaria and diarrhoeal diseases (Asante A at al 2011). In 2002 the vast majority (85%) of the 341,000 poor people lived in rural areas of the country (NDP 2002). Of these, the poorest groups were in households that had small landholdings or were headed by fishermen. Poverty incidence was higher among households headed by parents with no schooling and declined with a rise in educational achievement (level) of the household head. In 2002, the incidence of poverty among those with no schooling was 49%, of fishermen: 47%, and of farmers: 46% (NDP 2002).

After independence, the Timor-Leste government policy was to restore the health sector, targeting health services to particular groups in order to achieve the greatest health impacts. In 2002 the Ministry of Health developed a Basic Service Package (BSP) for primary health care and the Hospital Service Packages (HSP) for clinical care, to consolidate the country's Health Sector Strategic Plan (Asante et al 2011). In the same year, the Ministry of Health (MOH) initiated the first National Health Policy Framework (NHPF) for the next decade. The NHPF gave priority to the health needs of the East Timor people which addressed the importance of understanding the social determinants of health within the local cultural context (NSD 2010). The policy sought to stipulate health quality for the Timor-Leste people by establishing and developing a

cost-effective and needs-based health system that specifically addressed the health issues of children, women and other vulnerable groups, particularly the poor, in a participatory way (NSD 2010).

A major military and political crisis occurred between April–May 2006. The crisis began as a conflict between elements of the F-FDTL (Military of East Timor) over discrimination within the military, and expanded to a coup attempt and general violence throughout the country, centred in Dili. The crisis prompted military intervention by several other countries and led to the resignation of the Prime Minister. The crisis brought about significant loss of life, personal injury and widespread destruction of property. As the result, about 15 percent of the entire population (up to 150,000 people) left their homes and were displaced. More than 64 camps for displaced people were established in Dili and then supported through the delivery of services (Zwi et al. 2007). The instability continued for the next two years. Due to the turmoil the majority of Timorese were dislocated from their homes and ended up in internally displaced person (IDP) camps in the country and in West Timor. The IDPs were be unable to access adequate health care, clean water, food, shelter and sanitation for almost three years. Concerns over the situation were raised by the local leaders, the World Health Organization (WHO) and International Non-Government Organizations (NGOs). The concern was that such conditions would bring about increasing levels of malnutrition and disease outbreaks and increased mortality due to malaria, upper respiratory infections, diarrhoeal disease, vaccine preventable diseases and mental health problems (Rosser 2013).

Between 2007 and 2009 the incidence of poverty in Timor-Leste declined by nine percentage points and life expectancy at birth increased by over two years (Ministry of Finance 2010). Despite these achievements, health care provision was still weak and health standards were poor.

Though the Timor-Leste Ministry of Health has made progress in providing health services, access to health services in the country, especially in rural areas, is significantly lower than that in urban centres. A number of rural villages do not have a health post and some are not even served by mobile clinics. Access to most qualified doctors and nurses is virtually non-existent in most rural areas. In the early 2014, the government of Timor-Leste had added 700 new medical doctors trained in Cuba to the

country's medical workforce and it is expected to add a further 328 doctors who are training in the National University of Timor-Leste by local health professionals and the Cuban medical brigade by 2017 (Asante et al. 2014). Apart from these health issues, access to safe water, sanitation and electricity is also low in rural villages. Moreover, poor access to roads and communications is also a major problem in remote areas. Access to health services is better in Dili, where the main health facilities are located (a main/national hospital and 5 health centres) and where health professionals (GPs, specialists, etc.) are concentrated. There is a Paediatric Department in the national hospital with paediatricians available 24 hours to provide consultation and treatment to the children. There are also private health care services provided by NGOs and GPs in Dili.

1.6.1 Nutrition and Malnutrition

During colonial and occupation periods the nutritional status of the East Timorese was not a priority. Little effort was taken to improve the nutrition of the Timor-Leste people and those efforts were only partly implemented due to poor planning and insufficient funding. As a result, the number of children and pregnant women who suffered from moderate to severe malnutrition was still encountered in remote subdistricts of the country (UNDP 2009).

In the early days of its independence, Timor-Leste's social and economic policies focused on lessening poverty to address the immediate needs of people, consolidating security and stability and providing a foundation for nationhood through building institutions.

Subsistence agriculture is the main economic sector of the country, with 80% of the country's poor and 90% of the rural poor dependent on traditional staple foods like cassava and maize as a primary food source, but rice is replacing these as the preferred staple food (UN-WFP 2015). Timor-Leste's food insecurity and vulnerability is aggravated by floods, strong winds, drought and annual pest infestations, and as a result, loss of food production. Low food production by small-holders, as well as under developed local markets, has led to a dependency on imports. Raising agricultural productivity and rural incomes remain key challenges (UNDP 2009).

According to a survey on malnutrition (TLDHS 2009-10) conducted after the 2006 crisis reported that there was a slight rise in the level of stunting, wasting, and underweight after the turmoil. Stunting increased from 49 percent to 53 percent, wasting increased from 12 percent to 17 percent, and being underweight increased from 46 percent to 52 percent (NSD 2010). Due to the issue of malnutrition and problems in other sectors after the unrest, the Timor-Leste government laid out the Fourth Constitutional Government Program for 2007-2012 as the country's development strategy. The strategy defined its long term development goals in terms of reducing poverty and promoting the equitable growth and life of the Timorese population (NSD 2010).

In 2006, the Government of Timor-Leste focused its attention on recovering the economy and tackling the country's social problems. The focus was to achieve food security and reduction of poverty in the remote areas by 2020. However, the nutritional status of children remained a serious problem and remains significantly below the acceptable world standard.

Agriculture is the main field of work for the East Timorese living in rural areas, followed by forestry and fisheries. About 85 % men and 40% women aged 15-49 years were employed in the agriculture sector in 2009 (NSD 2010). However, productivity remains relatively low.

Under-nutrition was a main problem since the country obtained its independence and it was reported that poor maternal and child health were two major public health issues that resulted from many factors, including unavailability of fortified nutrition food; food taboos and dietary practices that lead to low consumption of nutritional food; low knowledge of breastfeeding and time to initiate appropriate complementary foods; poor access to health services; high incidence of acute respiratory infection and diarrhoea; inadequate sanitation and hygiene practices; geographical isolation and a lack of adequate infrastructure (UN-WFP 2015).

Malnutrition in young children and under-nutrition among women has been highlighted through the country's Demographic and Health Survey (TLDHS 2010) and recent surveys. For children, it was reported that 45% were underweight, 15% were severely underweight. Additionally, 58% of children aged under five years were stunted and

almost 33% were severely stunted. These three indicators show the severe state of malnutrition among young children (Noij 2011). According to the TLDHS 2010 the proportion of children who were thin for their height (wasted) had decreased from 25 percent to 19 percent and the percentage of underweight children had also declined by 8 percent over the previous two years. However, the percentage of severely underweight children remained the same. The report concluded that efforts to reduce malnutrition among children in Timor-Leste were showing positive results but still had a long way to go (NSD 2010).

Under-nutrition of women in Timor-Leste is especially a concern in remote areas. Reports over recent decades reveal the reduction of under-nutrition in women; however the figure remains high with more than one third of non-pregnant women aged 15–49 years and a quarter of men of the same age group suffering from chronic underweight with Body Mass Indexes below 18.5. This indicates a severe lack of food security (TL-SDP 2011). The most common forms of malnutrition found in Timor-Leste in 2010 were protein energy malnutrition (PEM) and micronutrient deficiencies (NSD 2010).

Timor-Leste's Strategic Development Plan forms an integrated package and a road-map of strategic policies to achieve the country's vision of a sustainable and inclusive development which aligns with United Nation's Millennium Development Goals (MDGs). Through a joint effort between the Government of Timor-Leste and the United Nations-Millennium Development Goals Achievement Fund, (UN-MDGAF) a program to reduce malnutrition and under-nutrition was initiated in 2009. Several issues were covered by the program i.e. high level of food insecurity, inadequate access to health and nutrition services, high incidence of acute respiratory infection, malaria and diarrhoea, poor knowledge on young child feeding and caring practices (including breastfeeding) (GOTL 2009). In terms of food insecurity, it was reported that during the lean season (from October to March) the situation becomes more severe, especially in remote highland areas, among subsistence farmers and female-headed households. The main contributing factors of insecurity of food during the lean season were identified as inadequate staple food production and storage, recurrent natural disasters and low availability of quality seeds and other inputs for agriculture (Noij 2011).

According to Timor-Leste National Statistics Directorate, the country imported goods worth $670 million in 2012. Principal import categories in 2012 were electrical

machinery, fuel, electrical appliances, machinery, books, beverages, vegetables, cement, plastics, and cereals (including primary rice and sugar). Sugar imports into Timor-Leste are mainly from Indonesia and are 0.34 percent of all imported goods (National Policy and Strategy of the Ministry of Agriculture, Forestry and Fisheries 2004) (MAFF 2008). However, data on per capita sugar intake is not available. Rice and maize are mainly imported from Vietnam and Indonesia. In Timor-Leste, rice and maize are equally important as staple food crops, however, land suitable for rice production is limited and maize is more widely grown (National Policy and Strategy of the Ministry of Agriculture, Forestry and Fisheries 2004).

The UN-MDGs Achievement Fund identified agriculture of primary importance for 2020, aiming at attaining food security in the country and to diminish poverty in rural areas. Efforts are also being made to assist farmers to change the subsistence farming to commercial farming of crops, livestock and fisheries, improved farming practices and enhanced productivity. The program is especially focused on rice, maize and other staple food crops, fruits and vegetables and niche cash crop products and is implemented in districts of Timor-Leste which were identified as United Nations convergence districts, namely Baucau, Manatuto, Aileu and Oecusse (Noij 2011).

In order to improve the nutritional status of the Timorese, the Government of Timor-Leste (GOTL), via the analysis of MDG 1 on reduction of poverty and hunger, proposed an agenda for improving the nutritional condition of lactating women and young children (Noij 2011). It included prioritizing nutrition interventions for children under two years and pregnant, lactating mothers and adolescents, increasing the reach of education to promote increased feeding practices, including exclusive breastfeeding and timely introduction of complementary feeding; building community awareness, acceptance and engagement with nutritional services; establishing peer support mechanisms such as Mother Support Groups (MSG), Parent Teacher Associations (PTA), community health and nutritional champions and networks of community health volunteers; providing micro-nutrient supplementation (Vitamin A, ion, iodine, etc.) and food fortification (salt iodization) in consideration of food diversity; treating acute malnutrition at health facilities and at community level; the provision of safe drinking water and promotion of improved hygiene and sanitation in schools and communities (GOTL 2010, Noji 2011).

GOTL also started a program via community mobilization and Mother Support Groups in cooperation with a local Non-Government Organization (NGO): the Alola Foundation. This is a strong proponent for exclusive breastfeeding for children 0-6 months of age in Timor-Leste.

1.7 The Importance of Oral Health

Oral health is a core component of human wellbeing and is known to closely relate to general morbidity. The World Oral Health 2003 Report concluded that dental caries and periodontal disease are major public health problems worldwide (Petersen at al 2005). It further stated that poor oral health may have a profound effect on general health. Oral diseases restrict activities at school, at work and at home causing millions of school and work hours to be lost each year throughout the world. Problems with communication, eating, smiling, chewing due to damaged, discoloured and missing teeth have a major impact in people's daily lives and well-being (Petersen at al 2005). The report also stated that tooth decay, otherwise known as dental caries, and periodontal disease are considered as the two most prevalent oral diseases in children and adults. About 60-90% school-aged children in industrialized countries are affected by dental caries (Petersen et al, 2005, Selwitz et al, 2007).

Dental caries is a common preventable disease affecting adults and children throughout their lifetime and is a chronic disease with a multifactorial aetiology (Baelum 2003). The current dental epidemiological statistics reported by the World Health Organization on the level of dental caries as measured in 12 year-olds by the Decayed, Missing and Filled Teeth index (DMFT) shows that dental caries experience is relatively high in the United States (3.0) and in the European Region (2.6) (Petersen et al 2005). In African countries, the DMFT values appear to be less common at 1.7. Barmes (1999) reported that the DMFT of 12 year old children in developing countries continues to remain low to very low, 1.2–2.6 teeth and 0.0–1.1 teeth respectively. This trend of dental caries, however, is predicted to increase in the coming decade due to increased exposure to foods containing refined carbohydrates that is inevitable with urbanisation (Barmes 1999). Studies on the changing incidence of dental caries across the world have revealed that urbanisation contributes changes in living conditions, while exposure to food containing sucrose escalates the incidence of caries (Barmes 1999).

The impact of oral disease is large when measured by societal indicators, such as restricted activity, bed disability and days of work lost (Reisine, 1984; Sternbach, 1986; Spencer and Lewis, 1988; Gift and Redford, 1992). It is not surprising that more and more links are being found between oral and general health. For example, in the area of child birth, the severity of gingivitis has been found to be correlated with sex steroid hormone levels (Hugosan 1971, Raber-Duracher et al. 1993), It has been found that periodontal pathogens can cross the placental barrier (Kornman and Loesche 1980, Moore and Moore 1994), and that periodontal infections may be associated with pre-term/low weight births (McGregor et al. 1995, Novy et al. 1995), and periodontal treatment may reduce pre-term/low weight birth rates (Lopez et al. 2005). Hence, the importance of pregnant women receiving dental care cannot be overestimated.

Chronic diseases such as diabetes mellitus may display a bidirectional relationship with poor oral health (Taylor 2001). Diabetes and periodontal disease are two chronic diseases that have long been considered to be biologically linked (Mealey and Rose 2008, Taylor and Borgnakke 2008, Mealey and Oates 2006). Many studies report the adverse effects of diabetes on the onset, progression and severity of periodontitis (Taylor and Borgnakke 2008, Mealey and Ocampo 2007). The prevalence of periodontitis in diabetic subjects is estimated to be double or even triple that of the general population. There is a growing body of evidence supporting the fact that periodontal infection with gram-negative microorganisms adversely affects glycaemic control. Furthermore, a meta-analysis indicated that periodontal treatment leads to an improvement of glycaemic control in type 2 diabetic patients (Gerdes et al. 2010).

The literature suggests that periodontitis might contribute to atherogenesis and thrombosis. Periodontal disease is thought to cause changes in cardiovascular risk factors. For example, severe periodontitis has been associated with adverse changes in blood pressure and in serum cholesterol levels. There has been some evidence that periodontal disease may be associated with cardiovascular disease, irrespective of confounding factors such as smoking (Williams et al. 2008).

It is possible that the accumulation of periodontal pathogens may increase the risk for lower respiratory tract infection, including pneumonia and chronic obstructive pulmonary disease. Although the potential mechanisms are obscure, the most direct one involves the aspiration of oral bacteria into the lower respiratory tract. The more severe

the gum attachment loss, the greater the association with chronic obstructive pulmonary disease (Scannapeico and Ho, 2001). Well-controlled studies have documented the effectiveness of systematic oral care in preventing or reducing aspiration pneumonia and pneumonia-related transfers to hospital for residents with dementia (Yoneyama et al. 2002, Watando et al. 2004).

1.8 Oral Health in Timor-Leste

Timor-Leste, after realising its independence from Indonesia in the wake of its 1999 referendum, faced an urgent set of challenges in oral health, such as high rates of oral cancer and periodontal disease associated with entrenched habits of tobacco smoking and betel nut chewing, and heightened risk of dental caries associated with shifting dietary habits, limited fluoride exposure and inadequate provision of preventative dental treatment. There was no national oral health policy and strategy during Portuguese colonisation or the 24 years of Indonesian occupation. During the occupation period, oral health was not seen as a priority sector of health in Timor-Leste. As such, information is not available on the oral health of the Timor-Leste population prior to 2002.

The first Timor-Leste National Oral Health Survey (AusAID 2002) was conducted in the early years of independence to provide data and information needed to establish an oral health status profile of the East Timorese and develop an Oral Health Strategic Plan and Policy (OHSPP). The survey was undertaken in 2002 by dental epidemiologists of the University of Adelaide led by Professor Kaye Roberts-Thomson (AusAID 2002). The survey found the vast majority of children and adults (over 85%) had never made a dental visit, and less than half the adults who reported having made a dental visit did so to a dentist or dental nurse; some visits were made to general medical practitioners, but nearly half were made to other providers such as traditional healers. The burden of dental caries was found to be moderate to low in both groups, likely linked to a subsistence farming diet, but this was mostly untreated or treated by extractions not performed by dentists or dental nurses (AusAID 2002).

The survey found the oral health status of the Timorese was poor. This was due to limited access to oral health information, alteration in socio-economic conditions and recent changes in eating patterns (TL-NOHS 2004). In addition, factors such as

smoking, betel quid chewing, lack of health education and infrequent dental visiting were also playing an important role in increasing the burden of oral diseases (dental caries and periodontal disease) among Timorese children and adults.

The survey reported that the prevalence of dental caries among children 6-8 years–old was 72.6% (dmft 3.4), compared with 46.8% (dmft 1.5) among those 9-11 years old. Dental caries experience was also high among those aged 12-17 years old. DMFT for children age 12-14 and 15-17 years old was 1.84 (66.3%) and 1.91 (67.2 %), respectively. In children, the presence of calculus was 77.8% and the prevalence of gingivitis was 25.9%. The majority (57.7%) of children aged 6-8 years had brushed their teeth the previous day, but 88.5 % had not ever made a dental visit. Of those who had attended a dental clinic, pain was the main reason for the consultation (AusAID 2002). The report concluded the overall level of caries experience was "low" to "moderate" only; however it was twice that of Australian children.

In adults, the survey reported that nearly 60% of the group had experienced toothache at least once during the last 12 months. This acute condition was highly prevalent among adults (90%). The mean number of permanent Decayed, Missing or Filled teeth (DMF-T) among adults was 5.3, with a DMFT of 3.3 in adults 18-34 years old and 8.6 in adults aged 45+ years. Approximately one in ten adults reported with good periodontal (gum) health. The majority of the adults had gingivitis or accumulation of dental calculus. The prevalence of advanced periodontal disease was age related, with the highest prevalence in the 45+ year's age group (AusAID 2002). It also found that betel quid chewing was practised by 38.3% of adults, with a higher percentage of female adults (57.7%) than male adults (22.6%) reporting chewing betel quid. Betel quid chewing (especially if tobacco is in the quid) is an identified risk factor for oral carcinoma (TL-NOHS 2004). Over three quarters of adults reported brushing and over 70% reported using toothpaste. Over 70% of male adults were current smokers and most female adults and almost a quarter of male adults chewed betel nut (AusAID 2002). Oral cancer, although rare in East Timor, poses a special challenge for oral health programs considering it is both preventable and lethal (TL-NOHS 2004).

Upon the completion of the 2002 survey, recommendations were made to the Ministry of Health of the Democratic Republic of Timor-Leste. As noted in the report, the

proposed endorsements which were later adopted as oral health policy directions and strategies by the MOH were as follows:

1.8.1 Population Oral Health Promotion Integrated with General Health Promotion

This policy direction covered oral health promotion in the areas of anti-smoking, anti-betel quid chewing, pre- and post-natal oral health, and smoking and betel quid chewing cessation. The approach of these recommendations was focused on oral health education and on encouraging decision-making, community awareness, and behavioural change to prevent caries, periodontal disease and oral pharyngeal cancer. Schoolchildren, pregnant women and mothers of young children, preschool children and people who smoke and chew betel quid were the targets for oral health education (TL-NOHS 2004).

1.8.2 Specific Population Health Promotion

This endorsement comprised three main aspects including school-based dental health education and a screening and fissure sealant program, affordable toothbrushes and toothpaste, and salt fluoridation. The school dental service was a specific program which included school-based oral health education, reinforcing the anti-smoking and anti-betel quid chewing messages, the importance of fluoride in the prevention of dental caries and the use of affordable toothbrushes and toothpaste. These messages were to be integrated into the general health education curriculum. The use of fluoride toothpaste and toothbrushes were encouraged to prevent dental caries and it was recommended that these should be widely available and affordable.

Salt fluoridation was identified as the single most effective, safe and inexpensive method to be implemented in Timor-Leste in terms of reducing dental caries. The policy further stated that if Timor-Leste chose to introduce salt fluoridation it was quite possible that the level of dental decay would be comparable to that of children in the few developed countries that have experienced significant reduction of dental caries (TL-NOHS 2004).

1.8.3 Provision of Personal Dental Treatment

The final recommendation covered oral urgent treatment (OUT), atraumatic restorative treatment (ART) as part of school-based dental care program and routine dental care as

part of personal dental treatment with a primary health care service. The OUT included the maintenance as well as delivery of emergency care (NOHS-TL 2002). In order to become effective, emergency care and the relief of pain are to be provided in areas and places where people work and live to ensure that emergency care was made available for all Timorese. The policy recognises ART as the effective and cheaper method of protecting the surfaces of molar teeth from decay. Furthermore, both ART restorations and Fissure Sealant enable the delivery of dental preventive treatment which in turn meets the principle of PHC (Primary Health Care) that comprise of prevention, appropriate technology, affordable treatment and equitable distribution of services (TL-NOHS 2004).

Oral health will remain a significant health problem in Timor-Leste in the next decade if there no action taken to reduce the prevalence of dental caries and periodontal disease. As traditional diets have been replaced by a more westernised diet (TL-NOHS 2004), it is probable that dental caries experience has increased since the Timor-Leste National Oral Health Survey 2002. Though the Ministry of Health has implemented messages about vaccination against contagious disease and family planning, there is no public education concerning prevention of dental caries and other oral diseases. While the National Oral Health Strategy addressed the importance of integrating oral health into general health, (TL-NOHS 2004) it is not clear how this integration will occur. The improvement of oral health status of children will be far below expectations while the oral health sector continues to remain a low priority. Currently, Timor-Leste has only 50 dental nurses and 10 dentists with an average of one dentist per 120,000 people.

There was no water fluoridation program implemented in Timor-Leste since Portuguese colonization and Indonesia occupation. Since independence up to the present time, there has been no study done to describe the level of fluoride concentration in public water. Through the school dental program in Dili, students were encouraged to brush their teeth with fluoridated toothpaste. While this program was not implemented regularly, the 2002 survey report revealed that almost all children brushed their teeth with fluoridated toothpaste. Only few children in the oldest age group did not use toothpaste when brushing teeth (AusAID 2002).

The Timor-Leste Ministry of Health provides oral health services to the Timorese at dental clinics at the national level and in districts and sub-districts throughout the

country. The clinics offer basic dental treatments such as simple tooth extraction, scaling, minor oral surgery as well as restorations. However, there is very little preventive oral health service provision in clinics around Timor-Leste. The annual budget allocated to the oral health sector has been centred mostly on treatment and diagnosis of dental disease, rather than on promotion and prevention programs. Though the government has established dental clinics and provided them with semi-sophisticated dental equipment and materials, the treatment intervention alone might not reduce the burden and the increase in oral disease in the country.

Cultural diversity in East Timor also plays an important role in determining people's perception of health and disease and this influences the way they seek health care (TL-NOHS 2004). Presently, there are about 50 dental nurses and ten dentists with an average of one dentist per 120,000 people. In comparison with Australia, the average practicing rate in 2009, as reported by the Australian Institute of Health and Welfare Dental Statistics Research Unit, (DSRU) was 54.1 dentists per 100,000 of population (SPC Dental Workforce 2012). In East Timor, almost all oral health professionals are employed by the government to work in dental clinics that are located in one main hospital, five referral hospitals, and 67 health centres across the country. The dentists are employed in the national and referral hospitals, while one or two dental nurses are placed in the health centre of each district, with limited dental materials and equipment. Currently, there are about two Timorese and four foreign dentists running private dental clinics in Dili.

1.9 Oral Health in School Children Living in Developing and Developed Countries

This section provides background information on the oral health of schoolchildren. The literature on caries prevalence and experience is restricted to children 6-17 years-old in Timor-Leste and several developing countries.

The dmft scores of deciduous teeth and DMFT scores of permanent teeth of Timor-Leste's children are significantly correlated with oral hygiene practices, the use of dental services, oral hygiene and oral health status in the country (NOHS-TL 2002).

1.9.1 Dental Caries (Tooth Decay)

Dental caries or tooth decay is a common chronic disease worldwide and is found in children and adults of all ages. The 2002 Oral Health Survey of Timor-Leste reported that about 72.6% of Timor-Leste children aged 6-8 years suffered from dental caries, while in adults the disease affected approximately 90% of those aged 35-44 years old (NOHS-TL 2002).

There are various explanations of dental caries but all agree that dental caries is an infectious disease resulting in demineralization of tooth structures by the acids produced by bacteria (Ritter 2004). Parker and Jamieson describe dental caries as a chronic infective disease on the enamel surface of teeth resulting in loss of minerals from teeth by-products (acids) of bacteria (Parker 2007). Likewise, Featherstone (2008) described dental decay as being caused by acids produced by bacteria diffusing into hard tissue and dissolving the mineral hard tissue of teeth. More recently, dental caries was defined as an infectious disease that occurs from localised destruction of dental hard tissue by acid products from bacterial fermentation of dietary carbohydrates (Chankanka 2011).

Dental caries has long been considered as the most prevalent oral disease in children and adults worldwide. About 60-90% school-aged children in industrialized countries are affected by dental caries (Petersen at al 2005b). As noted above, the Timor-Leste 2002 report revealed that dental decay affects more than half of Timorese children aged 6-11 years and 90.4% of adults aged over18 years. Specifically, the percentage of dental caries in the primary dentition of those aged 6-8 years was 72.6% (dmft= 3.4) and almost all of their caries experience presented as untreated decayed teeth. Meanwhile, caries percentage in those aged 12 and 25 years were 66.3% and 67.2% (DMFT= 1.7; 1,8) respectively and almost all the decay experience presented as untreated decayed teeth (NOHS-TL 2002). The vast majority of Timor-Leste Children did not visit a dentist and the main reason for visiting was when their tooth was painful. The most frequent treatment was for tooth extraction and prescriptions and very few children were reported to have had their teeth checked by the dentist. Approximately three quarters of children commenced tooth brushing after 5 years old and that was found among those age 6-8 years old only. (NOHS-TL 2002).

Although tooth decay is infrequently associated with mortality, the disease is a cause of considerable morbidity (Ha et al 2013). Dental caries may have a profound effect on general health. The chronic disease restricts activities at school, at work and at home, causing millions of school and work hours to be lost each year throughout the world. Problems with communication, eating, smiling and chewing due to damaged, discoloured and missing teeth have a major impact on people's daily lives and well-being (Petersen et al 2005).

Microbial Biofilm (Dental Plaque) and Dental Caries

Dental plaque (biofilm) is considered as a predisposing factor to dental decay. The thin biofilm is generally consisted of micro-organisms, salivary components such as mucin and desquamated epithelial cells adhered on tooth surfaces after the formation on the salivary pellicle using selective attachment factors (Parkash 2002). In addition, to facilitate colonization of micro-organism on the tooth surfaces, a few specific receptors of salivary molecules will be exposed to bacteria and adsorbed to tooth surfaces and this mechanism involves protein-protein or carbohydrate-protein bonding (Marsh 1995). In-vitro studies demonstrated that the initial colonization of bacteria on tooth surfaces is a result of adhesion activity of salivary protein, and the formation of lactic and other acids in microbial biofilm (plaque) is a result of interaction between cariogenic bacteria (mutan streptococci) and sucrose. This lactic acid plays a significant role in demineralizing enamel structure with a pH value below 5 (Balakrishnan 2000). The enamel is destroyed (demineralized) by the acid and then the disintegrated enamel is mechanically removed by forces of mastication. As micro-organisms penetrate along the dentinal tubules, the dissolution of dentin taking place in the same manner as occurs on the enamel surfaces (Parkash 2002). However, if frequent exposure to sucrose is reduced, then the rate of remineralisation will exceed that of demineralization and caries development will be arrested (Balakrishnan 2000).

Causational and Risk Factors for Dental Caries

Tooth decay develops as the result of complex interaction amongst several factors over time. These include host factors (teeth condition, and saliva), fermentable carbohydrates in food and drink and acid-producing bacteria (Ha et al 2013). There must be at least four interacting factors for cause tooth decay. These include teeth (host), diet (carbohydrates), bacteria in biofilm (mutan streptococci and lactobacilli species) and time (Selwitz et al

2007). Remineralisation (redepositing of minerals through saliva on tooth structure) takes place when half dissolved crystals are induced to grow by the redepositing of minerals via saliva (Ha et al 2013). The balance between demineralisation and remineralisation on the affected tooth determines the progress or reversal of dental caries.

The outcome of tooth decay depends on a dynamic balance of protective factors which cause remineralisation and pathological factors that play an important role in demineralisation of tooth structures. Pathological factors consist of: (1) sub-normal saliva flow and function, (2) acid-producing bacteria, and (3) frequent drinking/eating of fermentable carbohydrates. Protective factors involve: (1) saliva flow and components, (2) antibacterials such as chlorhexidine and xylitol, and (3) fluoride – remineralisation with calcium and phosphatase (Featherstone 2008).

Characteristic tooth decay is initiated with the loss of mineral ions on the tooth structure (demineralization) and several factors are playing important roles when the process takes place. According to Mount and Hume (cited in Ha el 2013), there are five main factors which employ great influence on the occurrence and development of dental caries.

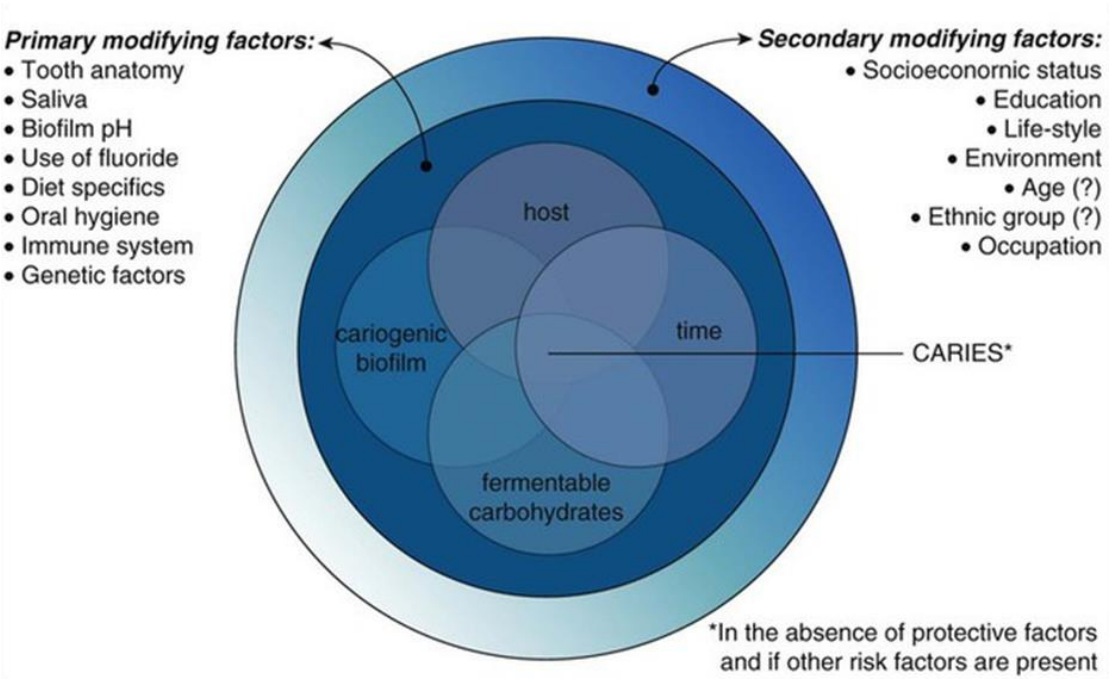
These factors are:

1. Frequent consumption of food and drink that contains fermentable carbohydrate. This allows plaque-bacteria that attach to the surface of tooth to produce the concentration of organic acid that can dissolve the tooth.
2. Retention and accumulation of plaque on tooth surfaces, where this is the main source of media for bacteria to produce acid on the surfaces;
3. Regular exposure to food containing acids in addition to bacterial acids;
4. Exposure to fluoride and some other trace elements, which help control the development of caries;
5. Saliva (natural protective factor) which may assist in the protection or limit the progress of tooth decay (Ha et al 2013).

Apart from the five factors mentioned above, physical, biological and behavioural factors have also been recognised as risk factors for dental caries. The inadequate composition and flow of saliva, and the high number of cariogenic bacteria, insufficient fluoride exposure, gingival recession, need for special health care as well as genetic factors are some of the physical and biological risk factors for caries (Selwitz et al

2007). Behavioural factors include poor oral hygiene and dietary habits, frequent use of medication that contains sugar, and inappropriate methods of feeding infants. Moreover, children who have a history of caries or siblings or caregivers with severe tooth decay should be considered as at increased risk for dental caries (Selwitz et al 2007). Research has also linked dental caries with low birth weight. Though little evidence is available to prove the correlation, dentists are advised to consider low birth weight children as at risk for tooth decay (Burt et al 2001). Furthermore, factors such as poverty, deprivation and low economic status and low level of education have also been regarded as other risk factors (Ramos Gomez et al 2002).

Figure 1.2. Aetiological model for dental caries as adapted from Keyes-Jordan



Population Measures of Caries

The prevalence of dental caries and the population variation in the distribution of caries experience are expressed according to the criteria of the World Health Organisation (WHO). Caries prevalence is expressed as the percentage of the population with tooth caries at a given point of time, whereas the population variation in the distribution of caries experience is shown by the mean number of decayed (D/d), missing (M/m), and filled (F/f) teeth (DMFT/dmft) (WHO 1997). When written in capital letters, the DMFT index is applied to the permanent/secondary dentition with scores ranging from 0 to 28 or 32, depending on whether the third molars are included in the scoring. However, when the index is written in lower case letters, it expresses the number of affected teeth in primary dentition, with score ranging from 0 to 20 for children. For a child, the caries experience is expressed as the total number of teeth that are decayed (d), missing (m), or filled (f) (Lo 2014). The scores used by the WHO to categorise caries experience: 0.0 – 1.1 DMFT (very low), 1.2 – 2.6 DMFT (low), 2.7 – 4.4 DMFT (moderate), 4.5 – 6.5 DMFT (high), or >6.6 DMFT (very high) (Jong 1993).

Trends and Variation in the Distribution of Dental Caries

Dental caries has historically been considered an essential global oral health problem. Results from epidemiological surveys demonstrate that most industrialized countries have experienced a decline in dental caries prevalence over the past decade (Petersen et al 2005). This achievement is due to several public health measures, including the changing of living condition and lifestyles, together with effective utilization of fluorides and improved self-care practices (Haloe and Hougejorden 1981). At the present time, the severity and distribution of dental caries varies in different parts of the world and within countries or regions (Petersen et al 2005).

An assessment by the WHO reveals that dental caries affects 60-90% of schoolchildren and adults in most developed countries (Petersen et al 2005). In a few Asian and Latin America countries, the dental caries experience of 12 year old children is also prevalent (WHO 2003). Further epidemiological information updated by the WHO in 2004 on the level of dental caries, as measured in 12 year-olds by the Decayed, Missing and Filled Teeth index (DMFT) shows that dental caries experience is relatively high in 12 year old children in the United States and in the European Region, at 3.0 and 2.6 respectively (Petersen et al 2005). However, caries prevalence is less common and less severe in African countries, where the DMFT index is 1.7.

The changing trends of dental caries are associated with several factors or conditions. Most oral diseases, in particular dental caries, are closely linked to unhealthy environments and to life-styles that include diets rich in sugar, poor oral hygiene and inappropriate exposure to fluoride (Petersen et al 2005). Although the levels of dental caries have been declining in industrialized countries in recent years, caries experience as well as the prevalence of dental caries are likely to increase in developing countries in accordance with changing living conditions, especially as a result of inadequate exposure to fluorides and growing consumption of sugar (Petersen et al 2005). In addition to the factors mentioned above, socio-behavioural risk factors have also been reported to play significant roles in the occurrence of dental caries in both children and adults in the countries in which excessive amounts and frequent consumption of sugars are major causes of dental decay and the risk of decay is high if population exposure to fluorides is inadequate (Petersen et al 2005).

A study conducted in the Philippines by Reyes in 2001 found that the index of Decayed, Missing and Filled Tooth (DMFT) was 4.58 among 12 year old children. This high score of caries experience was attributed to unfluoridated water, limited coverage of health insurance and inadequate dissemination of information on oral health (Reyes 2001). The prevalence of dental caries among children aged 12 years was 91.7% (Reyes 2001). According to the country's annual report in 2003, dental caries remains the top chronic disease among schoolchildren (Navarrez 2003). A recent study by Yabao et al (2005) among children aged 6-12 in La Trinidad, Benguet in the Philippines revealed that overall the dental caries prevalence was found to be 92.3%. The caries prevalence in primary and permanent dentition were 71.7% (dmft: 4.12) and 68.2% (DMFT: 2.40), respectively. The author concluded that the frequent consumption of sugar on a daily basis was the main reason for the occurrence of caries in the population studied. The study shows that 50% of the dental caries was contributed by the frequent consumption of foods containing high sugar (Yabao et al 2005).

Despite significant oral health achievements in non-industrialized countries, dental caries is still a major public health problem, for example in Libya. The country's dental epidemiological data indicates that the prevalence of tooth decay is high in all age groups. Amongst 12 year-old Libyan children in Tobruk and Benghazi, the DMFT scores increased from mean 0.78 in 1989 to 1.63 in 2000 (Huew et al 2012). This increased score of caries experience has been associated with the lack of dental awareness, unhealthy dietary habits (high sugar in diet) and the absence of public caries prevention programs. A current investigation involved 791 of 12 year-old schoolchildren in Benghazi, Libya found that 57.8% had experienced dental caries. The proportion of subjects who had evidence of dental caries was found to have a significant association with fruit-based sugared drinks consumption (Huew et al 2012).

The trend in caries reduction can also be attributed to factors including community water and salt fluoridation, decline in sugar consumption, fluorides in toothpaste, fluoride rinsing, and improvement in oral hygiene and used of antibiotics (Sheiham 1984). In a few developing countries, community water and salt fluoridation programs have made a greater contribution to declining caries prevalence and experience. An example of caries reduction is the case of Jamaica. In 1984, the DMFT score of 12 year old children in the country was 6.7 (Warpeha 1985). However, since the Carribean

country implemented salt fluoridation program nationwide in 1987, the mean index of caries experience of 12 year-olds had dramatically reduced to a very low level. An initial survey conducted in 1995 found that the DMFT scores of 12 year-old children in the country was reduced to about 1.1 teeth. This trend of caries reduction was attributed to the benefit of salt fluoridation (Estupinan et al 2001). Salt fluoridation to a concentration of 250 mg/kg program was first initiated in Jamaica in 1987 (Warpeha and Marthaler 1995). In a previous study (Warpeha 1985) conducted prior to the introduction of fluoridation salt in the country found DMFT values of 6.7 among 12 year olds. However, there has been a dramatic declined to 2.2 teeth during the last seventeen years (Meyer-Luecker et al 2002). The substantial reduction in DMFT has been attributed to the successful implementation of the fluoridation program.

Similarly, in the developed world, in Nevada in the United States, community water fluoridation has long been considered as the most cost-effective and safe community based approach to improving dental health (Ditmyer 2010). It was reported that the DMFT indices were almost two times in the areas without water fluoridation. An investigation in the state found that DMFT indices among children aged 12-15 years in the case group was higher (6.6 teeth) compared to the NHANES (National Health and Nutrition Examination Survey) data which was 1.7 teeth (Ditmyer 2010). Additionally, caries experience in those 16-19 years old was found to be 7.4 teeth and 3.3 teeth respectively. The high caries experience indices were encountered mainly in the African American and Hispanic communities who had no access to community water fluoridation and low income and education levels (Reid 2004).

Dental epidemiological reports have revealed the trends and distribution of dental caries throughout the world. These reports show that DMFT score is lower in rural areas compared to urban areas. DMFT scores in some countries are static. While in some developed countries the scores of DMFT is low to very low compared to some developing countries where caries prevalence are higher (Barmes 1999). The reports also elucidate factors such as high consumption of sugar, inadequate exposure to fluoride, poor living conditions, poor implementation of preventive services, lifestyle and environmental factors have all been linked with high caries prevalence (Petersen et al 2005). Additionally, other factors such as changes in treatment philosophy, as well as in diagnostic criteria, also influence the pattern of occurrence of dental caries.

1.9.2 Caries Prevalence and Experience in Developed and Developing Countries

Age-Related Caries Experience in Primary Dentition (Appendix 1A)

A number of studies have examined the prevalence of dental caries among children in developed and developing countries. The majority of these studies described dental caries experience in primary dentition of children aged 6 to 17 years. The statistical data of caries experience in the primary teeth from 2000 to 2011 are presented in appendix 1A.

Overall, caries experience in primary dentition varied between countries. The dmft score ranged from 0.5 in Delhi, India (Grewal 2011) to about 2.3 in Timor-Leste (NOHS-TL 2002). These scores are classified by the World Health Organization as 'very low' to 'low'. The mean decayed, missed, and filled tooth (dmft) in Southern China was highest of all countries studied at 6.5. This dmft score is categorized as 'high' and this caries severity presented predominantly as untreated decayed teeth with very low number of missing (extracted) teeth among Chinese children (Wong 2001).

Among children aged 3 to 14 years old residing in developed and developing countries, the prevalence of dental caries in primary teeth as revealed in the above mentioned studies was greater than 60%. Particularly in Riyadh, Saudi Arabia, where the percentage of dental caries reached a peak of about 90%, with a mean dmft of 3.8 teeth (Al-Banyan 2000). This was the highest percentage of caries experience found among the children in the studied countries. Wong (2001) reported that the prevalence of dental caries found in 5-12 year old children in Southern China was also high (84%). Male children in rural areas were reported to have a high percentage of dental caries (90%) compared to those of urban areas (78%).There was no significant difference in percentage of caries between females in the two areas. In contrast, a low percentage of dental caries was encountered in rural areas of different countries, in Tamil Nadu, India (Saravanan et al. 2008) and in Accra, Ghana (Bruce, et al, 2002). In these areas the caries rate reported was 29% in children aged 5-10 years, and 31% or less in children aged 4-16 years, respectively.

The caries free percentage among male and female children aged 3-14 years in the countries surveyed was lower than 60%, while in a few countries it was below 30%. A dental survey conducted in Alogoniha, Brazil reported that the caries free rate of

children 4-6 years old was 21% and within this age group the caries free rate of male and female children was 21.9 % and 24.4 %, respectively (Fernandes 2009). The children 6-10 years old of Undaipur, Rajasthan, India were 36.8 % caries free, slightly higher than Alogoniha in Brazil which was 21.3%. Female children had a caries free rate slightly higher (40.9%) than male children (33.1%) (Dhar 2009). A high caries free rate was found only in those aged 5-10 years in Tamil Nadu, India, at 71% (Saravanan et al. 2008). While in Accra, Ghana the number of males and females without dental caries was 69% (Bruce 2002).

The mean dmft of decayed, missing and filled teeth also varied between the countries studied. It was interesting that the lowest and the highest mean dmft of the studied countries was encountered in the two nations with the highest population in the world, China and India. As reported in the table in Appendix 1A, the overall scores of caries experience in primary dentition seemed to increase along with the increasing age of the children. The lowest dmft score (0.5) was found in children in urban Delhi, India. In this group, nine year old children were more affected by caries with a mean dmft of 2.1, and this was mostly comprised of decayed component (Grewal 2011). The highest mean dmft was reported in Southern China's male and female children. The dmft scores reached a peak (6.5) at around 5-12 years age group. Males in rural areas of Southern China were reported to have slightly higher dmft than female in the same area, at 7.7 and 6.4, respectively (Wong 2001). The overall dmft score for both male and female children in rural Southern China was 7.0. This figure was very high compared to the dmft score of 0.5 among Delhi Indian children of both sexes. Furthermore, as presented in Appendix 1A, high caries prevalence was also found in Alagoinha, Brazil and in Sana'a city, Yemen. Fernandes et al (2009) reported the relation between fluoride content in drinking water in Brazil and age-specific caries experience. In the Brazil study, the overall mean dmft of children 4-6 year old in areas where the drinking water had been fluoridated was 4.4. There was no significant difference in mean dmft among males and females in the study site. The authors concluded that the high caries experience was possibly due to an inadequate oral health system and due to limited access to dental health services. Meanwhile, a study conducted in Sana'a City, Yemen, found mean decayed, missed and filled components of children in the age groups of 6-8, 9-11 and 12-14 were 6.6, 3.6 and 1.1 teeth, respectively. The statistics clearly show that the dmft scores decreased along with increasing age (Al-Haddad 2010).

Age-Related Caries Experience in Permanent Dentition

A considerable number of dental epidemiology studies have been conducted to describe the dental caries experience in the permanent teeth of children aged 6-17 years in urban and rural areas of developed and developing countries. These studies provided statistical data on the permanent dental caries experience from 1998 to 2012 as shown in the table in Appendix 1B.

Caries Experience (DMF-T) in Permanent Dentition (Appendix 1B)

The mean DMFT of Decayed, Missing and Filled Teeth varied significantly between the countries studied. The highest mean DMFT score of 7.9 teeth was reported in 12 year-olds in Kaunas, Lithuania (Machiulskiene 1998), followed by China where the highest DMFT score of 5-12 year old was reported to be slightly lower (6.5) than those of Lithuanian children. These scores for caries experience were classified as 'high" according to the criterion determined by the World Health Organization (WHO 1997). The scores of caries experience in 5-12 year-old Chinese children where further broken down by gender and region. The study found that females and males in urban dwellings share the same score as female and males in rural dwellings (0.9) of Decayed, Missing and Filled teeth. There appeared to be no statistically significant difference between DMFT and age for the studied population (Wong 2001).

Low caries experience in permanent dentition has been described in Kasese and Kisoro, Uganda (Rwenyonyi et al, 2001); Darwin, Australia (Jemieson et al, 2010); Tamil Nadu, India (Saravanan et al, 2008) and in Timor-Leste (AusAID 2002). The lowest permanent dentition caries experience was reported among 10-14 years-olds in Kasese and Kisoro, Uganda. In that country, the DMFT score was reported at 0.3 and mostly comprised of Decayed (DT= 2.0) (Rwenyonyi 2001). The same score was also reported among 6-8 year-olds indigenous children in Darwin, Australia with the numbers of Missing and Filled teeth similarly (Jamieson 2010). A slightly higher DMFT score of 0.4 was reported among 9-10 years old of Chidambaram-Tamil Nadu, India. The male children of this age group had a slightly higher DMFT score than the female group, 0.5 teeth and 0.3 teeth respectively (Saravanan et al. 2008). In Timor-Leste, the low score of caries experience in permanent dentition (DMFT= 1.8) was found among those aged 12-17 years. East Timorese children aged 12-14 shared a similar mean of DMFT with the entire population studied. Only those aged 15-17 years old had a slightly higher

DMFT score of 1.9 but this difference was not statistically significant. The real difference was reported among the gender groups where females had higher Decayed, Missing and Filled teeth scores compared to male group, with 2.0 and 1.6, respectively (NOHS-TL 2002). This range of scores is classified as 'very low' to 'low' (WHO 1997). There seemed no direct correlation between the children's age and the DMFT scores.

Caries Free Teeth in Permanent Dentition Appendix 1B

There was considerable variation in the caries free rate among the countries included in this review. The caries free rate in permanent teeth of children 6-17 years old was ranked from 4.1% for school children in Sana'a City, Yemen (Al-Haddad 2010) to about 73.5% among schoolchildren of the same age group in Tamil Nadu, India (Saravanan et al. 2008). Additionally, a pathfinder survey carried out in Iran found that caries free percentages among those aged 9 and 12 years old were 19% and 32%, respectively (Movahed 2011).

Slightly lower than Tamil Nadu, the figure was recorded at 69% among the 4-16 year-olds in Accra, Ghana (Bruce 2002). Within the age groups in the Accra study, the highest percentage of caries free teeth (84%) was encountered in 13-16 year-olds while the lowest (74%) was among those aged 10-11 years. About 78% caries free was found in children 12 years old (Bruce 2002).

Prevalence of Dental Caries in Permanent Dentition Appendix 1B

The highest caries prevalence (90%) in permanent teeth was found among 5-12 year-old children in Riyadh, Saudi Arabia (Al-Banyan 2000). In southern China (Wong 2001) and Chandigarh, India (Goyal et al. 2007) the caries percentage varied between 84% and 80% respectively. For 12 year-old children of both sexes in urban and rural areas of southern China shared equal percentage of dental caries (41%). These figures indicate a slightly lower caries percentage than those of Riyadh's children, but statistically they had no significant differences. In Timor-Leste, a high caries rate (66.7%) was recorded among children aged 12-17 years (NOHS-TL 2002). A very low caries prevalence (15.8%) was observed among 10-14 year-olds in the rural areas of Kasese and Kisoro of Uganda (Rwenyonyi 2001).

In the case of China, China's National Oral Health Survey (Ying 2002) carried out a year after Wong's (2001) reported a slight increase in the percentage of dental caries among children aged 12 years. The report revealed a slight increase in the percentage of dental caries among 12 year-olds from 41% in 2001 to about 45% in 2002. Additionally, a slight rise in percentage to about 52% among those aged 15 years was also reported (Ying 2002). In Chandigarh, India the prevalence of dental caries among children aged 12 and 15 years was 80% and 87% respectively (Goyal et al. 2007). While in Timor-Leste, the rate of caries prevalence was reported at 60% among those aged 12- to 14- years (NOHS-TL 2002). There appeared to be little relationship between caries prevalence and age among all countries studied**.**

1.9.3 Dental Caries Experience of Children and Other Risk Factors

Caries Experience and Socio-Economic Status (SES) Appendix 1C

A developing country by definition is a nation with undeveloped industrial base and a low Human Development Index (HDI) relative to other countries. In general, the country has a low standard of living and has not attain a significant degree of industrialization relative to their population. The criteria used to classify a nation as a developing country depends on the following factors: 1) people having low life expectancy; 2) people having little education; and 3) people having low income (WESP 2013).

The classification is based on the economic condition of the country, the level of development as measured by per capita gross national income (GNI), on geographical location and on ad hoc criteria. According to WESP the geographical regions for developing economies are found in Africa, South Asia, West Asia, East Asia, Caribbean and Latin America (WESP 2013).

There are four income groups used to group economies of countries which set each year in July 1. Classification by income does not necessarily reflect the development status of a country. Based on 2011 Gross National Income (GNI) per capita income countries have been grouped as high-income, upper middle income, lower middle income and low-income (WESP 2013):

- Country with GNI per capita income of US$1,026 or less is classified as Low Income Country

- Country with GNI per capita income of US$1,026 and US$4,036 is classified as Lower middle income country
- Country with GNI per capita income of US$4,036 and US$12,476 is classified as upper middle income country
- Country with GNI per capita income above US$12,476 is classified as a high income country.

The data related to the dental caries experience of children from a number of studied areas in developed and developing countries in terms of socio-economic status (SES) is demonstrated in the table in Appendix 1C. The index of caries experience was found to be varied between the children in the study areas. As shown in the table, the highest DMFT score was encountered in Lithuania which was 7.9 teeth. This score was associated with 12 year-old children from the semi-urban area in Kaunas which is classified as a low socio-economic (SES) area. The highest mean DMFT (7.9) was almost exclusively composed of teeth with active lesions and teeth with inactive lesion (Machiulskiene 1998).

The lowest DMFT score (0.4) was associated with 12 year-old children of the middle SES class in urban and rural areas of Khartoum State, the Sudan. According to the researcher the lowest DMFT score in the age group (12 year olds in Khartoum) was as a result of better oral hygiene and improved dietary habits (Nurelhuda et al. 2009). This score was similar to that of 1 to 15-year-olds in the urban area (Ibadan) of Nigeria (Popoola 2013). In particular, the caries experience indices among East Timorese children aged 12-14 and 15-17 year-olds of urban and rural were 1.8 and 1.9 teeth (NOHS-TL 2002). However, these scores were low when compared to those of Sarajevo's 12 and 15 year-old urban children, which were 4.2 and 7.6, respectively (Markovic 2013). The SES levels of the studied children in both countries were classified as high to low and middle class.

A DMFT value of 2.4 was noted in children 12 years-old in Sassari, Italy, and among those aged 8 to 10 years in Riyadh, Saudi Arabia. The children in these study sites were categorised as belonging to middle and low SES classes (Campus 2001). While the indices of caries experience (DMFT) of 1.8, 1.5, and 1.5 in children with ages range from 11 to 15-year-olds in Vientene, Laos (Jurgensen 2009), Hidalgo, Mexico (Loyola 2007) as well as in Mangalore, India (Suprabha 2013) were classified as 'low' to 'very

low' compared to rest of the DMFT values of the studied countries. The socio-economic status of the population studied in these urban and rural areas was classified as ranking from very high to very low levels.

It is noted from the table that the rate of caries prevalence in all areas of studied countries ranged from 48.6% in Hidalgo to 76.4% in Riyadh. These rates were associated with children described as belonging to urban and semi-urban areas. Overall, these data do not illustrate an obvious relationship between caries experience and social class.

Socio-economic status is an attribute of an individual represented by indicators of education, income, occupation, and employment status.

In countries outside Australia, the evidence indicates that lower social class patients tend to receive less expensive services than others (Conrad et al. 1984; Hazelkorn, 1985). For example, in Brazil, Leao and Sheiham (1995) when studying a population of adults aged between 35 and 44 years found that lower class subjects were more likely to have a poorer oral HRQoL.

A similar inequality in oral health occurs in Australia. Marked socio-economic inequality in oral health exists in Australian adults (Barnard, 1993; Slade et al. 1992, Sanders and Spencer, 2004; Sanders et al. 2006) and the gap appears to be widening (AIHW, 2001).

The reason why socio-economic factors are associated with oral health are still open to debate. Sanders and Spencer conjectured that socio-economic factors do not account for observed health differences directly, but rather are marking other genetic, social and psychological phenomena that drive variation in health (Sanders and Spencer, 2004).

Later, Sanders and colleagues (2006) used data from 3,678 Australian adults and measured socio-economic status at the small-area level and oral health by either missing teeth or the OHIP 14 score. They found that poor oral health was not explained by personal neglect, where personal neglect was defined as lack of dental visiting or dental self-care or both. Two criticisms can be made of making such a conclusion from this study. The first is that it was a cross-sectional study and hence cause and effect cannot

be determined. The second is that it depends on survey participants' perception of their own dental visiting and dental self-care behaviour.

Wamala and colleagues (2006) claimed that access to dental care explains socio-economic disparities in oral health. They utilised cross-sectional data from the large Swedish National Surveys of Public Health 2004 and 2005 (n = 17,362 and 20,037) and developed a socio-economic disadvantage index consisting of social welfare beneficiary, being unemployed, financial crisis and lack of cash reserves. After controlling for living alone, education, occupational status and lifestyle factors, they found that people with severe socio-economic disparities were 7-9 times as likely to refrain from seeking required dental treatment.

Research has shown a relationship between lower socio-economic status and poorer oral health but how each of the component measures interact with socio-economic status is still not clear.

Armfield (2005) described how education influences inequality in health in a number of ways. Firstly, it has a significant role in influencing socio-economic position, being a determinant of a person's labour market position which in turn influences income, housing and other material resources. Second, education prepares children for life by enabling practical, social and emotional knowledge for achieving a full and healthy life. Third, education plays a role in preparing people for participating in society, teaching about rights and responsibilities and educating people in regards to the use and availability of services.

In the United States, Gooch and colleagues (1989) found in a population of insured adults aged between 18 and 61 years, that having less education was associated with lower oral HRQoL than subjects with more education. Gift and co-authors (1996) had a similar result with a population of US adults aged 18 years or older.

In Australia, a higher proportion of people with an education of nine years or less had complete tooth loss, less than 21 teeth, dentures, missing teeth, root decay, a higher mean DMFT, more periodontal disease and more lower incisor tooth wear than subjects with an education of year 10 or more (Roberts-Thomson and Do, 2007).

They were also less likely to have visited a dentist in the last 12 months, to have attended a private dentist, to pay for their dental visit, to usually attend a dentist at least once a year, to usually attend the same dentist, or to usually attend a dentist for a check-up than their more educated counterparts (Spencer and Harford 2007). Less educated survey participants were less likely to have attended a dentist within the last five years and had more difficulty paying a $100 dental bill than those with at least a year 10 education. In contrast, subjects with the lower level of education were not as likely to avoid or delay visiting a dentist because of cost, than more educated subjects.

A higher proportion of survey participants with education of nine years or less avoided foods, rated their oral health as fair or poor and were more likely to perceive that they required dentures than more educated subjects (Harford and Spencer 2007). However, they were less likely to feel they required a check-up.

In a study of children's dental decay, Armfield (2005) asserted that out of the indicators for socio-economic status of income, education, employment, housing transport and mobility and its effect on oral health, the most important indicator is income.

Gooch and colleagues (1989) found an association between lower income and poorer oral HRQoL in a population of US adults.

In Australia people from households with higher incomes are more likely to have made a recent dental visit, to visit a private provider, to visit for a check-up and to visit at least once per year than people from households from lower incomes (Harford et al. 2004). Low income adults without private insurance are 25 times more likely to have had all their teeth extracted than high-income adults with insurance (AIHW, 2001).

Reports concerning research on the association of socio-economic status (SES) with dental caries experience in developing countries have been well documented. Most of these studies indicated a high level of caries experience in group of people with low SES. According to the World Oral Health Report (2003) access to a dental clinic in developing countries is poor and extraction of teeth is the most frequent treatment conducted to relief pain or discomfort. The low level of knowledge on the importance of oral health in these nations has led to an assumption that loosing teeth is a natural consequence of becoming old (ageing) (WHO 2003). In 1979 the world health body

announced that, “by the year 2000, the global average of dental caries was to be no more than 3 DMFT at 12 years of age”.

Oral Hygiene Habits and Caries Prevalence Appendix 1D

Data related to caries prevalence and oral hygiene habits is shown in the table in Appendix 1D. A large variety of oral hygiene agents was used for tooth cleaning in 15 out of 17 studies. As noted in the table, children started cleaning their teeth from an early age. The use of the combined method of oral hygiene (toothbrush and toothpaste) was found to be most popular (100%) among urban female children aged 12 years in Mathura City, followed by 15 - 17 year-old children in urban and rural districts of Timor-Leste (98.2%). Surprisingly, the rate of caries prevalence in this group was high at 67.2%. In Nairobi, Kenya, use of the combined method was found to be 96% among 12 year-olds in urban districts and was also correlated with the low prevalence of dental caries (37.5%). Only a small percentage (24%) of 12 year-old children in rural Bikita, Zimbabwe stated that they used the combined method for cleaning their teeth, and this usage was also related to caries prevalence (40.8%). As demonstrated in the table, despite the combined method being used by 98.2% of children in Timor-Leste, caries prevalence was 72% for children aged 6-8 years, 47% for 9-11 year olds, 66% for 12-14 years and 67% for children aged 15-17 years.

The utilization of toothbrush only as an oral hygiene method was popular in some studies. A high percentage of children (97.7%) aged 11-13 years utilized toothbrush only for cleaning their teeth in semi-urban Mangalore, India (Suprabha 2013). This figure was similar to the 2 to13 year old group in rural area of Hidalgo, Mexico (Cook 2008). The lowest percentage (39.4%) of children who practiced toothbrush only method was found among 12 year-old children in the rural area of Harare and Bikita, Zimbabwe (Mafuvadze 2013). In two studies, children did not use a toothbrush to clean their teeth. About 77.8% of 3 to 13-year-old urban children in Paraiba, Brazil did not utilize a toothbrush when cleaning their teeth (compared to 10.9% of 12 years children in Riyadh, Saudi Arabia who stated that they did not use the toothbrush and toothpaste though their parents were able to buy a toothbrush). There was no caries prevalence recorded for these children.

Traditional methods of tooth cleaning were also reported. These methods include chewing stick and datum, the use of charcoal, salty water and limestone. Datum is a twig of the Neem tree which is chewed and used as a brush. The leaves of the tree are also used as an antiseptic. A piece of twig is cut from a tree then flayed out at the end for brushing teeth. Datun was most commonly (57%) used by children in Haryana, India (Tewari & Tewari 2001), while chewing stick method was practiced by children in the rural areas of Kenya (Gathecha 2012) and Zimbabwe (Mafuvadze 2013), 30% and 48.3% respectively. These studies found no evidence of an association between caries prevalence and datum. Only about 4.0% and 2.1% of rural children in Kenya and India used charcoal as oral hygiene methods for cleaning teeth.

A majority of children (85.3%) in Bhopal in India were reported to have brushed their teeth once a day (Reddy 2013). In comparison to the Bhopal, children of the same age group in Mangalore brushed their teeth twice a day (83.8%) (Suprabha 2013). The low prevalence of twice daily tooth brushing (6%) among 12 year old urban children in Nairobi was reported to be associated with caries prevalence (Gathecha 2012). Brushing three times or more a day (62.6%) was reported among 3-13 year-olds of Paraiba, Brazil (Paredes 2009). Daily tooth brushing was reported in nearly all studies, except for children in Haryana (Tewari & Tewari 2001), Mathira west (Gathecha 2012) and Harare who used datum and stick (Mafuvadze 2013). The study of Sogi and Bhaskar (2002) reported that male children aged 13-14 years in Davengere, India had a slightly poorer oral hygiene status compared to their counterpart of the same age group. The oral hygiene index scores of these children were 1.52 and 1.40, respectively. The children from the lowest income group had the highest reported OHI score of 1.79.

Fluoride Exposure and Dental Caries

Research on fluoride effects on oral health commenced about a century ago; the concentration has been on the association of water fluoridation and dental caries, fluoride toothpastes, topical fluoride applications, and milk and salt fluoridation. A review of an extensive database on the effective use of fluorides concluded that water fluoridation and the use of fluoride toothpastes and mouthrinses significantly reduced dental caries prevalence and experience (Petersen 2004).

The concentration of fluoride in the drinking water is inversely associated with the prevalence of teeth decay. The WHO recommended a concentration of fluoride in drinking water range from 0.5mg-1.0mg/litre (WHO 1994). For prevention purposes in the area of dental health, fluoride preparation may contain 10,000 mg/litre in liquids, 4,000-6,000 mg/kg in local application, and 0.25-1 mg per tablet and 1,000-1,500 mg per kg of toothpaste (Slooff et al 1988). WHO Technical Report 846, 'Fluorides and Oral Health,' presents basic aspects of salt fluoridation (Marthaler et al 2005). Removing fluoride from a local drinking water supply by desalination could potentially exacerbate an existing or developing dental public health problem (Lennon et al 2004).

In a study to evaluate the systemic effect of water fluoridation on dental caries prevalence and experience in children 6-11 years old in Cheongju, South Korea found that 11 year-old children in the Water Fluoridation-ceased (WF-ceased) area who had consumed fluoridate water for about 4 years after birth showed significant lower DMFT than their counterpart in the non-WF area. While 6-year-olds who had not drank fluoridated water indicated higher dmft in the WF-ceased area than in non–WF area (Cho et al 2014). The author suggested that the systemic effect of fluoride ingestion via water fluoridation is important to prevent teeth from becoming decayed.

A research on the association of dental health and public water fluoridation in New South Wales by Armfield (2005) found that water fluoridation played a significant role in reducing caries experience in the majority of the Area Health Service (AHSs) regions. The mean dmft of 5-6 year-olds as well as the mean DMFT of 11-12 year-olds was significantly lower for children in fluoridated areas compared to non-fluoridated areas. The study also demonstrated that the Indigenous and non-Indigenous children who lived in fluoridated areas had lower caries experience compared to their counterparts who lived in non-fluoridated areas (Amfield 2005).

The WHO recommends for public health that every effort must be made to develop affordable fluoridated toothpaste for use in developing countries (Petersen 2004). A systemic review through the Cochrane Collaboration Oral Health Group concluded that fluoride toothpaste reduce the DMFS 3-year increment by 24-26% (Martinho et al 2004).

A systemic review of 258 articles via Medline and Cochrane databases revealed strong evidence of the effective prevention of teeth decay through utilization of fluoride

toothpaste. It was reported: (i) that the caries preventive effect of daily use of fluoride toothpaste was greater compared to that of a placebo in the young permanent dentition, (ii) that toothpaste with 1,500 ppm of fluoride had a superior preventive effect on a young permanent dentition, (iii) that higher caries reduction were recorded in studies with supervised toothbrushing compared with non-supervised (Twetman et al 2003)

The first results of salt fluoridation in reducing dental caries were obtained in Switzerland, Colombia and Hungary (Marthaler et al 2005). The decline in the prevalence of dental caries was obtained in all three countries in studies conducted among children (Marthaler et al 2005). Studies showed the persistence of the caries protective effect into adulthood (Radnai and Fazekas 1999).

In a meta-analysis to assess the caries prevention effect of salt fluoridation in the permanent dentition in children 6-15 years old from the time that salt fluoridation was introduced (a period 4 years in France and 11 years in Jamaica), Yengopal and colleagues found that there was a reduction in DMFT of 0.98 in children 6-8 years old, 2.13 in children 9-12 years old, and 4.22 in those aged 13-15 years (Yengopal et al 2010).

A previous study of salt fluoridation in Jamaica in 1995 (Estupinan-Day et al 2001) indicated a significant reduction in dental caries compared with the finding of the previous study carried out in 1984. The study reported that in 1995 the DMFT means were 0.2 at age 7, 0.4 at age 8, 1.1 at age 12 and 3.0 at age 15. The caries experience scores in permanent dentition of children 6, 12 and 15 years of age were lower than corresponding scores of 1.7, 6.7 and 9.6 obtained at the baseline examination in 1984 from children of the same age groups, respectively. In all age groups the prevalence of sound permanent teeth was 90% in 1995, and the prevalence of caries free at baseline of children aged 6, 12 and 15 years were 27.6%, 2.8% and 0.3% respectively (Estupinan-Day 2001). The major change in Jamaica during the interval was the introduction of salt fluoridation in 1987.

Driscoll and colleagues (1981) conducted a study to determine whether fluoride mouthrinsing in school provides additional caries protection to the teeth of children. After 18 month of the study they found that weekly and daily fluoride mouthrinsing provide significant caries-preventive benefits beyond those already secured from

consuming optimal fluoridated drinking water (Driscoll et al 1981). A similar study have also carried out by Laswell and colleagues (1975). The study revealed that after 28 months of the study, the weekly rinse group presented a reduction of 46% in DMFS increment, contrasted with the control groups. The daily group resulted in lower reduction in caries of 23%, which was not statistically significant (Laswell et al 1975).

Recently, Jagan and colleagues (2016) conducted a systemic review to determine the effectiveness of NaF mouthrinses in the prevention of dental caries. They reviewed 220 of 394 manuscripts related to reduction of clinical dental caries followed by mouth rinsing with NaF mouthrinses alone. They found that daily or weekly sodium fluoride (NaF) mouthrinse had a significant caries reduction among adolescents (Jagan et al 2016). However, two criticisms can be made of making such conclusion. The first is that very limited data were available to clearly demonstrate the effect of mouthrinsing on reducing dental caries in the primary dentition. Second is that there was limited evidence to prove that a fluoride mouth rinsing program should be started during preschool years.

Several studies have shown the effect of fluoride varnish on dental caries. There are also previous clinical trial studies have reported numerous results regarding the effect of sodium fluoride varnish on primary and permanent dentition (Holm 1979; Koch 1979; Murray 1977; Clark 1982). In 2006, the Weintraubs Clinical study also reported the reducing effect of varnish on dental caries (13). A comparable study to assess the effect of fluoride varnish on dental caries in a group of children aged 3-6 years in a Kreman kindergarden during 6 months period demonstrated a positive effect of fluoride varnish in preventing caries. The mean dmft in the first stage was 5.0, this then reached 4.8 in the third stage, which showed a reduction to 14%. The result of the study confirms previous studies (Mohammadi et al 2014).

Silver fluoride's dental caries arrest ability is derived from the combined effects of silver salt-stimulated sclerotic or calcified dentin formation (Stebbins 1891), silver nitrate's potent germicidal effect (Miller 1905; Martinho 2002), and fluoride's ability to reduce dental caries (Martinho 2002; Martinho 2004b; Martinho 2004a). As neutral silver fluoride can be unstable, it is dissolved in ammonia to form complex ions referred to as silver diamine fluoride (Mei 2013). In a systematic review (Rosenblatt et al 2009) concluded that the application of silver diamine fluoride arrests active caries, and

reduces the incidence of new caries. A very recent and thorough systematic review and meta-analysis (Gao et al 2016) found that professionally applied silver diamine fluoride is effective in arresting dentine caries. It undertook a search of publications from 1948 to 2014, a total of 2177 papers were found, and 17 randomised clinical trials were included. Meta-analysis was performed on five papers using silver diamine fluoride to arrest dentine caries and the overall proportion of arrested dentine caries was 65.9 % (p<0.001). They concluded that silver diamine fluoride solution at 38 % is effective in arresting active dentine caries.

Dental Visits and Caries Experience

Dental attendance has been found to be associated with a greater improvement of oral health status and quality of life. A study conducted in Australia found that the oral health status of adults residing in capital cities who regularly visited a dental service provider was better than those of people living in outside capital cities (AIHW 2004). The reason for this finding may be due to the type of oral health care likely to be given to urban compared to rural residents (AIHW 2004). Studies have also suggested that metropolitan residents had a better concept of health compared to people living in rural cities (Humphreys et al 1997; Coster and Gribben 1999).

Early dental office visits have been found to be associated with lower prevalence of dental disease. A study by Beil and colleagues to determine the association between timing of a first dentist office visit before age 5 years and dental disease in Kindergarten revealed that children who had visited at age 37 to 60 months had significantly less disease than children with a visit by age 24 months (Beil et al 2014). In addition, results of the study showed that children who had a primary or secondary preventive visit at age 37 to 48 or 48 to 69 months had a statistically significantly lower dmft score compared to their counterparts who had a visit before 24 months (Beil et al 2014).

A study to test whether dental attendance improved the Oral Health Related Quality of Life (OHRQoL) found that statistically significant interaction term indicated the prelateship between dental attendances (Crocombe et al 2012). In relation to this, a previous study by AIHW reported that people residing outside urban areas were more likely than people living in metropolitan areas to have problem-oriented pattern of

seeing a dental service provider, were less likely to make an annual dental visit, and were less likely to have a private dental provider that they usually visit (AIHW 2004).

Long-term patterns of dental visiting have also been found to be associated with caries experience. Aldossary and colleagues (2015) reported that the mean DMFT was lower in people who regularly attended dental clinic than those who never make dental appointment for dental check-up. By DMFT component, the study found that the mean number of decayed teeth in those who classified as always regular-regular attenders was significantly lower than in those of former and never regular-attenders (Aldossary et al 2015).

When investigating factors related with dental visits and barriers to utilisation of dental care services among antenatal mothers attending an Obstetrics and Gynaecology clinic, Saddki and colleagues found that the majority of the mothers (67%) had good dental health status even though only 29% of the mothers visited a dentist during the current pregnancy. Reasons for them to attend dental clinic before ging birth were exposure to oral health education before and awareness of relationship between poor maternal oral health and adverse pregnancy outcomes with odds ratio 4.06 (Saddki et al 2010).

Regular dental visit have a tendency to affect the dental service received for two reasons. First, regular attendees are less likely to suffer acute symptoms and require emergency treatment (Sheiham et al. 1985; Todd and Lader, 1991; Murray, 1996; Kay, 1999). Second, the treating dental clinician when deciding on whether to undertake an intervention that is borderline in needing to be done, is more likely to "watch and wait" with a patient who usually attends for a check-up than one who usually attends a dentist with a problem. The treating dental clinician may reason that a regular attendee is more likely to re-attend the dental clinic in the near future than an irregular attendee, so that the condition has less chance to become a larger problem.

Dental attendance has also been found to be associated with subjective oral health. Gift and colleagues (1996) found that subjects in a population of United States adults aged 18 years or older who last made a dental visit more than 2 years ago had poorer oral HRQoL than those who had visited a dentist more recently.

A cross-sectional study utilising the Office for National Statistics and Omnibus Survey of a sample of 1,865 adults in Great Britain showed that dental attendance is positively associated with the perception of an enhanced quality of life (McGrath and Bedi, 2001).

Kressin and colleagues (1996) in a study in the United States on men aged 47 years or older found that problem-based dental visiting was associated with a poorer oral HRQoL. In the same year a similar result was found by Slade and colleagues when they compared the oral HRQoL of Australians, United States citizens and Canadian adults aged 60+ yrs.

A cross-sectional study of 4,176 Australian dentate adults found that the usual reason for the dental visit, and not the time since last visit or type of dental care supplied, accounted for differences in oral HRQoL (Crocombe et al. 2007). Therefore, it may not be the type of dental care received but rather the mindset towards dental care and its associated influence on behaviour and outlook that influences oral HRQoL.

Australian adults who usually attend a dentist with a dental problem ("problem visitors") rather than for a check-up are more likely to have less than 21 teeth, dentures, missing teeth, coronal and root caries, but less likely to have coronal restorations (Roberts-Thomson and Do, 2007). Problem visitors have a higher total DMFT, poorer periodontal health and more tooth wear than people who usually visit a dentist for a check-up.

Problem visitors are much less likely to have attended a dentist in the last 12 months and much more likely to not have attended for five years or more than subjects who attend a dentist for a check-up (Spencer and Harford, 2007). Similarly, problem visitors are less likely to have attended a private sector dentist or to have paid for their dental visit, and much less likely to usually attend a dentist once a year or usually attend the same dentist than their check-up visiting counterparts. Problem visitors were also more likely to delay or avoid dental care because of cost, had cost preventing recommended dental care, and had difficulty paying a $100 dental bill.

Perception of their oral health was also poorer among subjects who usually attended a dentist for a problem rather than a check-up. Problem visitors were more likely to avoid foods due to dental problems, rate their oral health as fair or poor, and to suffer from

toothache or orofacial pain than check-up visitors (Harford and Spencer 2007). They also had a greater treatment need for dentures, extractions and check-ups.

Savage et al (2004) in a study in children 1-5 years old of North Carolina found that children who had an early preventive dental visit were more likely to use subsequent preventive services and experience lower dentally related cost. Children who had their preventive visit by age 1 were more likely to have subsequent restorative or emergency visits. Those who had their first preventive visit at age 2 or 3 were more likely to have subsequent preventive, restorative and emergency visits. Children from racial minority groups had significantly more difficultly in finding access to dental care, as did those in counties with fewer dentists per population (Savage et al 2004). In addition, the average dentally related cost per child according to age at the first visit ranged from $339 for children agen 1 to 2 years to $546 for children aged 4 to 5 years old.

1.10 Gingival Conditions

Gingivitis (inflammation in the gum) is a general term which encompasses a range of acute and chronic conditions of the investing (gingiva) tissue of teeth (Cutress 2003). An assessment conducted in Timor-Leste fourteen years ago (AusAID 2002) found that the prevalence of gingivitis in children age 6-17 years old was 25.9% and approximately one-sixth of teeth examined had gingival bleeding. The report further revealed that the prevalence of gingival bleeding was significantly higher among the older age groups (15-17 year old) and among male children which were 36.8% and 26.9%, respectively. Although male children were likely to indicate more gingivitis than female children, the extent of bleeding was found to be similar between sexes (AusAID 2002).

Normal gingiva is coral pink in colour, firm in consistency with the orange peel appearance and knife edged deflective contours (Parkash 2002). In contrast, when the gingiva is inflamed (gingivitis) the gingiva becomes soft and oedematous. The surface stippling may also be lost and the surfaces may appear smooth and shiny or firm and nodular depending on whether the change is inflammatory or fibrotic. In advanced stages, the roots may be exposed by apical migration of gum. The condition is known as gingival recession. This may also be caused by high frenulum attachment, traumatic occlusion and the brushing methods used (Parkash et al 2004).

Although gingivitis is regarded as a reversible condition, if left untreated it can progress to periodontitis over time. The continuum and progression of gingivitis to periodontitis have been reported by the researchers for many years. The initial inflammatory process, gingivitis, affect the investing soft tissues around the teeth and this is regarded as the precursor of a deeper progressive inflammation, which adversely affects the tooth's investing and supporting tissues (Cutress 2003). However, the role of gingivitis in the pathogenesis of periodontitis remains controversial (Dietrich at al 2006).

1.10.1 Measurement of Gingival Bleeding

The state of the gingiva has to be accurately defined in any epidemiological survey of periodontal status. This is in order to be able to compare different population groups at a given time as well as to determine and control risk factors, and to access treatment efficacy (Benamghar et al 1982). The WHO Community Periodontal Index (CPI) is the common index used to measure the presence/absence of gingival bleeding (gingivitis) and calculus (periodontitis) in dental epidemiological studies.

In addition, when conducting an oral health survey, reliability and validity are the initial parameters tested before proceeding to periodontal and gingival measurement. These parameters are also applied when conducting the survey of dental caries in a study population. Validity indicates to what extent the index measures what it is intended to measure and its determination is dependent on the availability of a so-called validation criterion, whereas reliability is the ability of a given test to give the same result when applied twice to the same object (Poulsen 1981). In order to have reliable data of a patient in an oral health survey, the patient has to be examined twice by an examiner (Poulsen 1981).

The indices used in studies of the epidemiology of gingival condition have been well-documented and the common criteria used in these indices are accepted and used worldwide. The diagnostic criteria – bleeding or no bleeding (the absence or presence of bleeding after gentle probing on gingival sulcus) – is regarded as the useful measurements in epidemiological and clinical trials (Ainamo and Bay 1976). Likewise, the index described by Loe and Silness is also useful in oral health surveys. According to these authors, the scores applied to the gingival condition range from 0-3 ["0": if the gingiva is normal, "1": if the gingiva has mild inflammation, "2": if the gingiva has

moderate inflammation, and "3": if the gingival condition is in severe inflammation] (Loe and Silness 1963). Further diagnostic criteria of gingival condition developed by Suomi and Barbano (Suomi and Barbano 1968) was improved by Suomi (Suomi 1969). These are commonly utilized in the surveys and are based on combination of criteria. The diagnostic criteria are based on changes in colour and volume of gingiva as well as the texture and the absence or the presence of gingival stippling. The scores and criteria applied to the gingival condition ranges from 0-2 ["0": absence of inflammation, "1": presence of inflammation, and "2": presence of severe inflammation] (Poulsen 1981).

1.11 Methods Used in Dental Epidemiological Surveys

A number of epidemiology studies on dental caries in children have been carried out to assess the prevalence of dental caries and caries experience (dmft/DMFT). Previous research has used cross-sectional studies, longitudinal cohort methods and randomised control trials (RCT).

A survey was carried out in the Khartoum State, Sudan aimed at assessing general oral health status of 12 year old children and to determine oral health risk indicators (Nurelhuda et al. 2009). The study collected data on the oral health status of the participants as measured by using the DMFT index using the WHO criteria (1997).

A study on the prevalence of dental caries and treatment needs of preschool children in a recently fluoridated town carried out in Brazil utilized a random sample strategy (Fernandes 2009). It evaluated the prevalence of dental caries and the treatment needs, in 4-6 year-old preschool children in a Brazilian town that had recently started a water fluoridation program. The 127 pre-school children were examined by calibrated dentists according to the codes and criteria of the WHO. The examination was performed in a public school by two examiners assisted by a noter under natural light. Tooth brushing was performed prior to examination. During examination time the child was asked to sit in a proclined position facing the examiner. (Fernandes 2009).

A dental epidemiology stratified random sample survey was conducted in 2007 in Chandigarh, India (Goyal et al 2007) to record incipient caries lesions in Chandigarh school children. Eight schools on the study area were selected randomly from a list of 80 schools. Of these participated schools, there was cluster of 1816 school children 5-6, 9, 12 and 15 years old selected to participate in the survey. Dental examination was

carried out by the main researcher using Moller's Index (1966) and the examiner attended repeated sessions of calibration and standardization training before commencing the survey. The survey collected information on dental knowledge, attitude and practice of the school children with regard to oral health measures (Goyal et al 2007).

A cross sectional study of 247 boys and 261 girls randomly selected from six schools in the study area to assess the prevalence of dental caries and to plan dental preventive treatment was carried out in Chidambaram, Taluk, Tamil Nadu, India (Saravanan et al. 2008). All participants were clinically examined by the main investigator for dental caries status according to diagnostic criteria recommended by World Health Organization (WHO 1997), and the chi-square test and two way analysis of variance were used for the purpose of data analysis.

In Uganda, a cross-sectional survey using multistage cluster sampling technique of oral health of 685 primary and secondary school pupils attending schools in five districts in the country to assess health status and health determinants of school pupils was conducted in 2003 (Wandera 2003). Two sub-counties were selected from each district, and one urban and one rural were randomly selected from each sub-county. Then two schools (one primary and one secondary) were chosen randomly from selected urban and rural areas. Students were randomly selected from every class of the selected schools, grade one to grade seven and secondary one to secondary six. Oral examination was carried out using a simplified version of Decayed, Missing and Filled teeth (DMFT) index and Community Periodontal Index (CPI). For the purpose of oral examination, five examiners were trained on using a standardized simplified version of Decayed, Missing and Filled teeth (DMFT) and Community Periodontal Index (CPI) according to WHO (1997) guideline for oral health survey (Wandera 2003).

A non-randomised cross-sectional survey was carried out in central and western Nepal (Yee 2002) to describe and to analyse the caries experience and caries prevalence in the deciduous dentition of 2,177 5-6 year-old school children and in the permanent dentition of 3,323 12-13 year-old schoolchildren. There were eight districts in western and central Nepal, 45 urban schools (10 private and 35 public schools) and 22 rural schools (all public schools) selected to take part in the survey. Clinical examination was performed in classroom where the children were sat in supine position under natural

sunlight. Mouth mirrors and cotton pellets held in cotton pliers were used to examine dental caries. The examination followed the WHO (1997) guidelines. The examiners were trained and calibrated on school children under field conditions. Inter-examination calibration was performed, and in every tenth student re-examination was performed to check for the intra-examiner reliability (Yee 2002).

A study of 639 children aged 12 years to delineate dental caries and oral health practices among 12 year-old children was carried out in Nairobi West and Mathira West districts, Kenya (Gathecha 2012). A two stage sampling technique was applied, and a stratified sampling technique was utilized to sample schools. Six schools were randomly selected from 54 schools in Nairobi West district and another 6 from 36 schools in Mathira West District. A total of 62 students were randomly chosen from each school. A questionnaire was used to gather information on consumption of cariogenic foods which were categorized into high, low and never consumed. The clinical examination of dental caries status was carried out via oral screening utilizing the WHO caries diagnostic criteria: Dental examination was performed in a classroom where the children were seated in an upright chair under natural sunlight. A calibration session was conducted to assess the consistency of examiners (Gathecha 2012).

A perspective longitudinal cohort study on the caries prevalence, severity, and 3-year increment, and their impact upon New Zealand adolescents' (430 aged 12 to 13 years) oral-health-related quality of life was carried out in Taranaki, New Zealand (Page, 2012). The household SES measure was based on the parents' occupations, classified in 2003 using the New Zealand Socio-economic Index. A single calibrated dental examiner recorded the dental caries status (permanent dentition) of each adolescent following the WHO guidelines (Page 2012).

The objectives of these studies differ slightly in terms of what the authors were looking at but in general, the main focus was at caries experience and prevalence. Nurelhuda (2009) seemed to relate dental caries and risk indicators, while Fernandes (2009) would prefer to relate caries with treatment needs. Likewise, Yee and McDonald (2002) and Goyal (2007) determined their study objectives by looking at dental caries experience and prevalence in schoolchildren. The methodologies used in these studies were similar except for the Taranaki study. In the study, the authors used a perspective longitudinal (cohort study) to follow the progress of the study population overtime. When

conducting these studies, the authors were more likely to adopt cross-sectional method using random sample strategy with probability proportional to size. There were little differences in terms of sampling the study areas and size of the population studied. Several authors would prefer to use multi-stage sampling technique while others were more likely to use two or three stages sampling method, but this depends on the length of study area and the preferred sample size. For instance, study by Yee and McDonal (2002) in Nepal involved 2,177 children, while study in Brazil involved only 127 children. The data collection methods used was via a questionnaire and clinical examination. The questionnaire was used to collect data on oral health behaviours, oral hygiene habits and attitude, dental visiting pattern and socio-demographic data, while the clinical examination form was used to record oral health conditions. Dental examination performed in these studies followed diagnostic criteria recommended by the WHO. Prior to commencing the surveys, a standardizing and calibrating session was carried out for the examiners to assess their consistency during dental examinations.

1.12 Conceptual Models Development

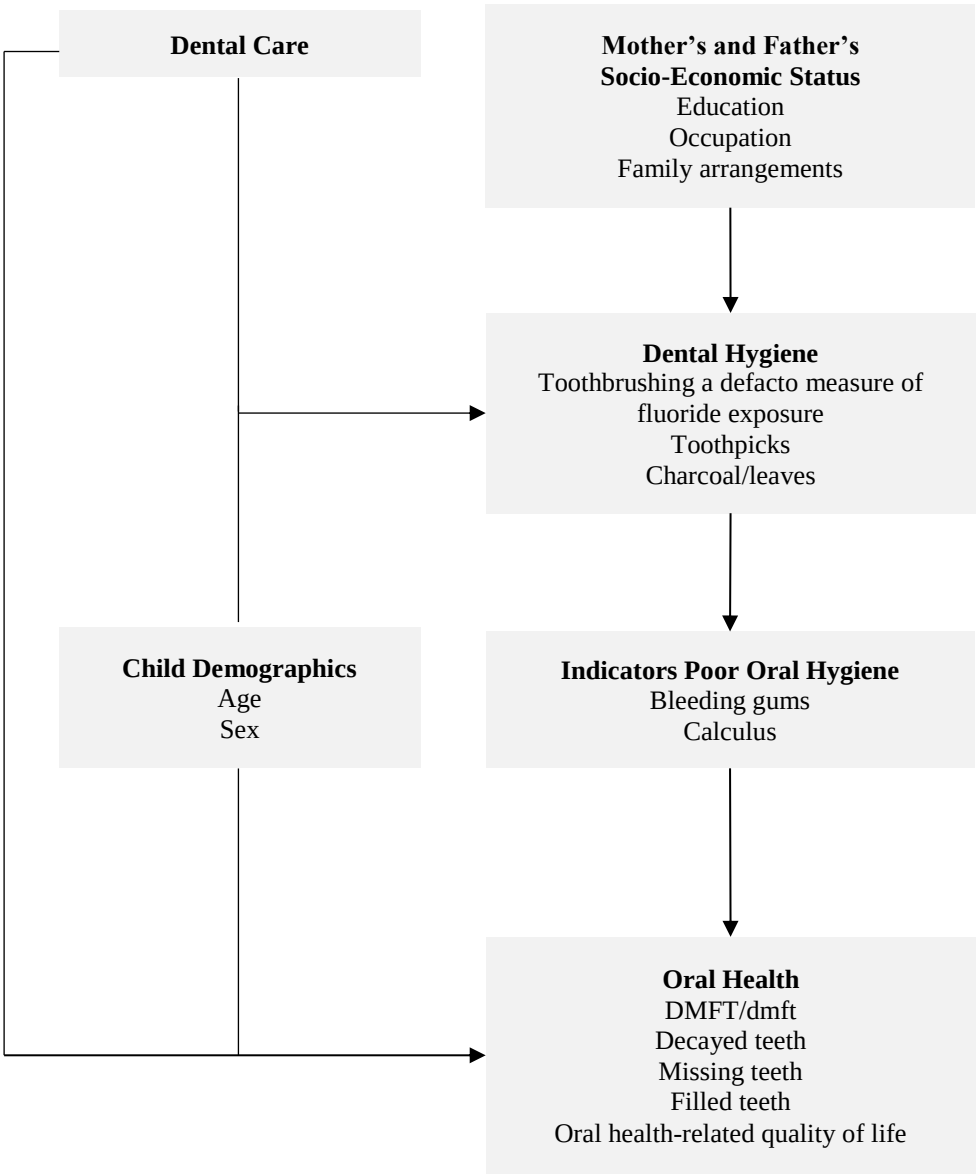
This section describes how the conceptual models and hypotheses for this study were developed. The first conceptual model developed was of the 2014 questionnaire and oral epidemiological examination (**Error! Reference source not found.**). From the preceding discussion it was apparent that the literature abounds with papers on variables that influence oral health status. Oral health is influenced by fluoride exposure, the socioeconomic status of the child's parents/carers, access to dental care, the child's age and sex, diet, and dental hygiene. There is no water fluoridation in Timor-Leste. The only access to fluoride is via toothpaste and at dental clinics. With only seven dentists, access to dental care in Dili is poor and so fluoride exposure from that source is low. All toothpastes in the two supermarkets in Dili contain fluoride. Hence, tooth brushing was taken as a de facto measure of fluoride exposure. Oral hygiene was obtained from the parent/carer questionnaire, but this was validated against bleeding gingiva and dental calculus prevalence. Access to dental care and dental hygiene was shown to be related to parents' socio-economic status and access to dental care influenced the child's oral hygiene practices. The author's local knowledge indicated that this was also true in Dili. Bleeding gums and the presence of dental calculus were used as

independent (from the parent/carer) indicators of oral hygiene. Bleeding gums was an indicator of oral hygiene adequacy for the previous few days prior to the dental examination, and the presence of dental calculus for the previous few months. Dental care and oral hygiene were associated with oral health outcomes. Dental care was expected to be associated with a different ratio between decayed, missing and filled teeth, but the DMFT/dmft indices were expected to remain the same.

For the conceptual model of the comparison between the 2002 and 2014 questionnaires and oral epidemiological examinations (**Error! Reference source not found.**), it was logical to use the same model as in **Error! Reference source not found.** but putting "change in" (Δ) in front of each variable. The change in oral health was expected to be associated with change in the same input factors as at the time of the 2014 questionnaire and survey.

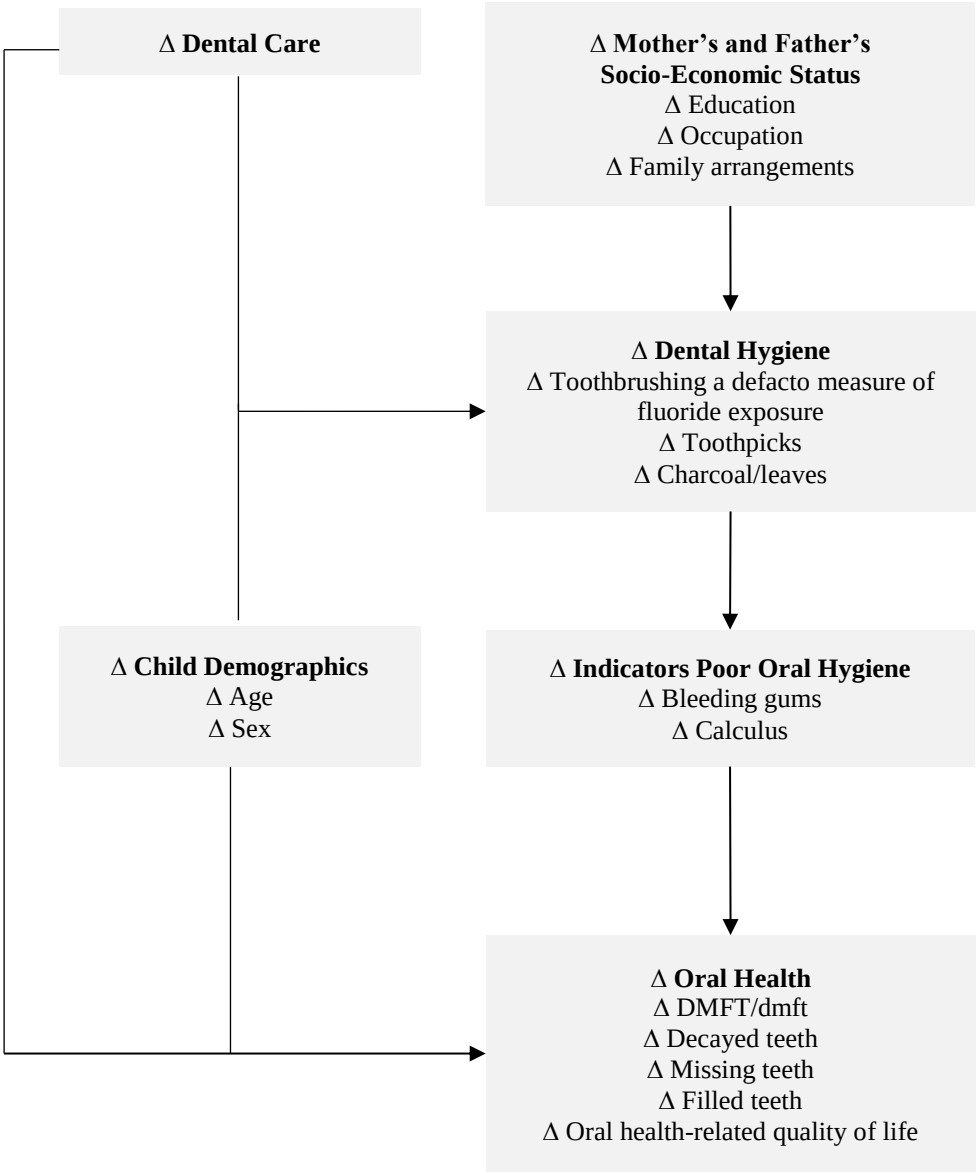
The conceptual model of the comparison between the 2002 and 2014 questionnaires and oral epidemiological examinations with the recommendations from the 2002 report included (**Error! Reference source not found.**) show how the recommendations, if implemented, would have influenced the conceptual model.

Figure 1.3. Conceptual model of the 2014 questionnaire and oral epidemiological examination



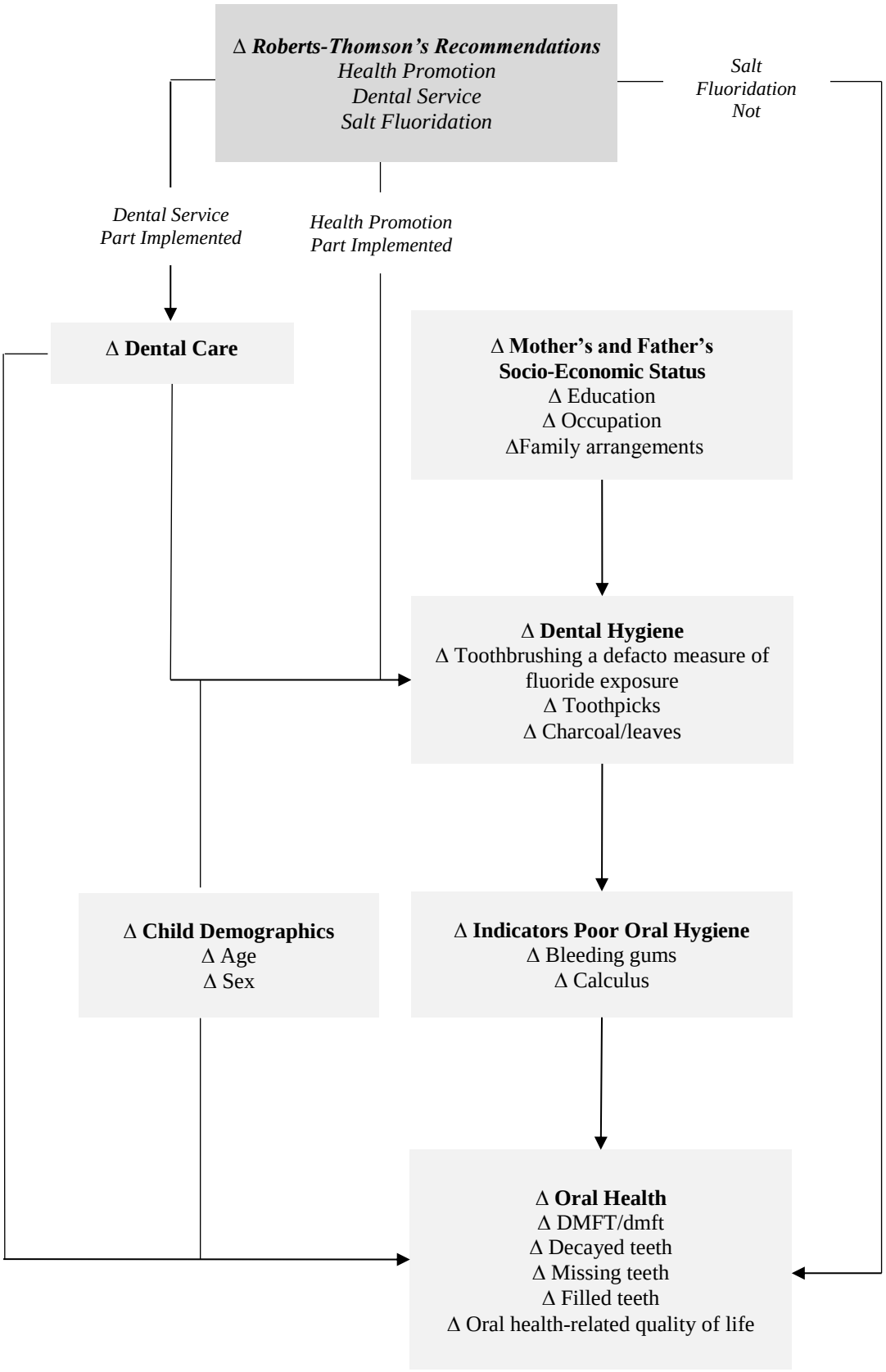
Variables Collected	
Questionnaire	**Oral epidemiological examination:**
Age Sex Education Occupation Family arrangements Dental hygiene Dental care Oral health-related Quality of life	DMFT/dmft Decayed teeth Missing teeth Filled teeth Bleeding gums Calculus Note: Diet was not collected

Figure 1.4. Conceptual model of comparison of 2002 and 2014 data



Variables Collected	
Questionnaire	**Oral epidemiological examination:**
Age Sex Education Occupation Family arrangements Dental hygiene Dental care Oral health-related Quality of life	DMFT/dmft Decayed teeth Missing teeth Filled teeth Bleeding gums Calculus Note: Diet was not collected

Figure 1.5. Conceptual model of comparison of 2002 and 2014 data with 2002 recommendations and outcomes



The 2002 recommendations and their outcomes are in italics.

Variables Collected		
Interviews	**Questionnaire**	**Oral epidemiological examination:**
Importance of report? *If implemented?* *If not, why not?*	Age Sex Education Occupation Family arrangements Dental hygiene Dental care Oral health-related Quality of life	DMFT/dmft Decayed teeth Missing teeth Filled teeth Bleeding gums Calculus Note: Diet was not collected

1.13 Rationale for Studying the Oral Health of Children in Timor-Leste

Dental caries is one of the most common health problems in Timor-Leste (AusAID 2002). There have been massive changes in the political and socio-economic situation since the 2002 NOHS.

This study set out to determine whether there has been a change in the prevalence of oral disease among children in the Dili district of Timor-Leste. This information will assist in the identification and implementation of effective policies to facilitate effective treatment planning and resource allocation to improve oral health among children in Dili and other developing regions.

1.14 Hypothesis

Main hypothesis:

Dental caries experience in the children of Dili had increased over the 12 year time span between the 2014 and 2002 surveys.

Sub hypothesis:

- Dental caries experience in children from low socio-economic status schools is greater than that of children from high socio-economic status schools.
- Untreated dental caries in children with lower education levels status schools is greater than that of children with parents of higher education levels.
- Recommendations from the Timor-Leste National Oral Health Survey 2002 were implemented.
- Updated oral health policies should be recommended.

1.15 Postscript

This chapter presented a background to the literature relevant to Timor-Leste history, the general and oral health context of Timor-Leste, an introduction to literature review relevant to oral health, caries prevalence and experience of children living in developing and developed countries, caries risk factors, gingival conditions and its measurements and a conceptual model development, described the rationale for studying the oral health of children in Timor-Leste and the hypothesis of this study.

In the next chapter **(**Chapter 2**)** a review of the Timor-Leste oral health policy documents, consultations with oral health policy stakeholders in Timor-Leste, the epidemiological survey of the oral health of children living in Dili and the development of oral health policy recommendations are described.

Chapter 2

Methods

2.1 Preface

The previous chapter, provides a background of the history of Timor-Leste and the general and oral health context of Timor-Leste. It includes an introduction to a literature review relevant to oral health and caries prevalence, the experience of children living in developing and developed countries, describes caries risk factors, gingival conditions and their measurements with the construction of a conceptual models development. A description of the rationale for studying the oral health of children in Timor-Leste and the hypothesis of this study is also presented.

This chapter describes the methods of the study conducted in 2014. The three components of the research are described in detail. These components comprise: a review of policy recommendations since the National Oral Health Survey in 2002, a survey of the oral health of children living in Dili and an oral health examination conducted with survey participants.

2.2 Ethical Considerations and Ethical Approval

Ethical considerations relevant to the study included the need to ensure participants were not subjected to risks such as psychological distress, physical discomfort or the risk of cross-infection during oral examinations.

The research was designed to avoid the risk of harm and discomfort to participants. All children who participated in the oral examination were examined in an open classroom, in the presence of their parents/guardian and teachers. This was to address issues of the unequal power relationship and to ensure the participants felt their participation in the research was their own choice. No treatment was provided to the students at the time of the examination. The equipment used for examination purpose was sterilized using a dental autoclave according to the sterilization standards and infection control protocol of Timor-Leste. All participants were informed that they were free to choose whether

or not to participate in the survey and were free to withdraw if they felt uncomfortable at any stage.

Prior to commencement of the study, approval was granted by the Human Research Ethics Committee of the University of Tasmania on 9 October 2013 (HREC reference number H13216) (*see appendix 7*). This ethical approval covered all three components of the research.

Each participant was allocated a non re-identifiable study identifier, which was recorded on dental examination records, questionnaires and interview transcripts. No personally identifiable information was recorded on any study materials. Consent forms, questionnaires and dental examination recordes were stored in a locked file cabinet in the School of Health Sciences, the University of Tasmania. Computer data files were saved to a password-protected secure network drive and were only accessable to the researchers.

2.3 Government Permissions

Permission to conduct the study was granted by the Departmento Saude Oral, Ministrio da Saude de Timor-Leste (Department of Oral Health, Ministry of Health, Timor-Leste), Ministry of Health of Democratic Republic of Timor-Leste and the Direcao Encino Basico e Encino Secudario, Ministerio da Educacao de Timor-Leste (Directorate of Basic and Secondary Education, Ministry of Education, Timor-Leste).

2.4 Review of Oral Health Policy Documents Related to Timor-Leste

2.4.1 National Oral Health Survey, Timor-Leste, 2002

Oral health policy recommendations from the 2002 National Oral Health Survey (AusAID 2002) included the integration of oral health promotion with general health promotion, and monitoring of the oral health of infants and children younger than school age as a component of general health check-ups (*see Chapter 7*). It is recommended that non-acidic and low sugar fluids should be promoted for consumption by young children, and with infants, bottle removal was encouraged after feeding. At the general population level, salt fluoridation, access to affordable toothbrushes and fluoride toothpaste was encouraged. The integration of traditional

tooth cleaning methods with fluoride toothpaste was further suggested. It was also recommended that an oral health promotion campaign should be delivered through schools, warning of the dangers of smoking and chewing betel nut, articulating the benefits of fluoride and encouraging tooth brushing and the use of fluoride toothpaste. It was recommended that a screening and fissure sealant programme could provide preventive dental care for older children. Personal dental care should be provided as both oral urgent treatment and atraumatic restorative treatment, while routine dental treatment should be integrated with the primary health service (AusAID 2002).

2.4.2 Timor-Leste National Oral Health Strategy 2004

The National Oral Health Strategy (TL-NOHS 2004) was released in 2004 by the Ministry of Health (MoH). It largely accepted the oral health policy recommendations of the National Oral Health Survey. It recommended salt fluoridation, affordable fluoride toothpaste, a School Dental Service and oral health to be integrated into general health promotion and focused on preschool children, pregnant women and mothers of young children, school children and people who smoke or chew betel quid.

2.4.3 Formulating an Oral Health Strategy for South-East Asia 2008

A World Health Organization (WHO) South-East Asia regional report (WHO, 2009) recommended that WHO Member States should undertake a situational analysis, that oral health is reflected in national health policies, to have oral health promotion and prevention plans, integrate oral health into other health programmes, adopt a multidisciplinary approach, strengthen the oral health workforce and establish surveillance of oral health and regular monitoring of oral health programmes.

2.4.4 World Health Organization (WHO) Framework 2010

The World Health Organization (WHO) framework - social determinants, entry-points and interventions to address oral health inequalities (Kwan 2010) published in 2010 gave an overview of international oral health policy (*see Chapter 7*). The framework recommended influencing the socio-economic context and position with its differential exposure and vulnerability to oral disease risk, and differential health care outcomes and consequences (Kwan 2010).

2.4.5 National Health Sector Strategic Plan 2011-2030, 2011

The National Health Sector Strategic Plan (MoH, 2011) noted that oral health was a priority within a range of essential health interventions, and that the most common problem was dental caries, but the treatment of the dental problems was "far beyond the capacity of the existing health workforce and the budget of the MoH" (p59). It recommended to ensure access to appropriate oral health services to the population, to re-orient clinical service delivery from a curative model of care to a blend of promotive, preventive and curative interventions, and to promote community awareness and participation in priority target groups (*see Chapter 7*). Key indicators were: increased scholarships for oral health professionals; 75% of health centres implementing oral health programmes, baseline data on periodontal diseases and oral cancer, and at least 35% of schools participating in oral health promotion and education.

2.5 Consultations with Oral Health Policy Stakeholders in Timor-Leste

2.5.1 Aims of Consulations with Oral Health Policy Stakeholders

The aims of this research component were to identify if the recommendations of the 2002 National Oral Health Survey (NOHS) had been implemented, and if not, to seek the perceptions of stakeholders as to why the recommendations were not implemented.

2.5.2 Identification and Recruitment of Participants for Stakeholder Interviews

We targeted health and oral health policy makers, dental clinicians and academics based in Timor-Leste to examine their perceptions of what they interpreted were obstacles to the implementation of the recommendations made in the 2002 report (NOHS-TL 2002).

Each interviewee was invited to participate in an interview by sending a written invitation (via mail or email) and a subsequent telephone call to plan the interview. Through the phone call, the interviewees were informed that they had no obligation to take part and could decide on whether to participate or not in the interview. In all, seven individuals were invited to participate in a one-on-one interview, either in-person or via phone call (Clovis et al 2012). Two individuals declined to participate. Both of these potential participants stated that they did not feel they had sufficient knowledge of the report and its recommendations.

2.5.3 Stakeholder Interview Methods

The semi-structured interviews were conducted in early January 2013 in Dili, Timor-Leste. Prior to conducting the session, the interviewees were informed about the interview procedures via the study information sheet and telephone calls to arrange interview times. Only those who provided verbal consent were interviewed. Interviews were conducted in the interviewees' offices, and lasted 30 to 40 minutes. All interviews were audio-tape recorded and the interviewer also took notes.

Five participants agreed to be interviewed. The key informants included two policy makers (Minister of Health and the manager of Oral Health Department), two dental clinicians (dentists) and a former deputy health minister.

The interviews were conducted by a clinical leader (the researcher). One of the participants preferred to be interviewed in English, while the rest of the interviews were conducted in the local language (Tetum). A tape recorder, Digital Voice Recorder VN-712PC, was used to record the information given by the interviewers. The information was translated by the researcher and transcribed in English.

2.5.4 Interview Questions

The interview was based on three open-ended questions that were designed to collect the information on the significance of the survey report conducted in 2002 (NOHS-TL 2002) and on any perceived barriers to the implementation of the recommendations.

The researcher used a semi-structured interview guide to focus the interviews. The guide was designed to assist the interviewer to identify obstacles that impeded implementation of the recommendations. The guide included a preamble with information on the NOHS and the aim of the interviews, and their comprehension of the oral health sector and its policy process.

The interview guide sought interviewees' perceptions of the implementation of the recommendations in Timor-Leste. The same three questions were asked to all participants and additional questions probing questions were asked when they provided new information, similar to a method used to investigate policy health makers in Canada (Clovis et al 2012). The questions covered three main themes: (1) the importance of the 2002 report and its recommendations; (2) whether the

recommendations had been endorsed and what was the current stage of implementation; and (3) perceived the barriers (if any) for implementing the recommendations. The questions guiding the stakeholders are show in **Error! Reference source not found.**. Since English is not widely used as communication tool in Timor-Leste, the questions were first translated into the local language (Tetum) in order to facilitate the interview process. The Tetum version of the questions was reviewed by two senior local dentists before conducting the interview.

Table 2.1. Stakeholder interview questions

Questions	Sub-questions
Did you read the report of the Timor-Leste National Oral Health Survey and its recommendations?	In what, if any, ways was the survey important?
	In what, if any, ways were the recommendations important?
Were the Timor-Leste National Oral Health Survey and its recommendations important?	What survey results do you think were most significant?
	What recommendations do you think were most significant?
Tetun version :	Tetun version:
Ita Boot le'e ona Survei Nasional Saude Oral Timor-Leste tinan 2002 no ninia rekomendasaun sira? Survey ne'e no ninia rekomendasaun sira importante ka lae?	Oinsa mak survey ne'e importantante?
	Oinsa mak rekomendasaun sira ne'e importante?
	Resultadu ida nebe mak ita boot hanoin signifikante liu?
	Rekomensaun sira nebe mak ita boot hanoin signifikadu liu?
Have the recommendations of the report been implemented?	What is the current stage of implementation?
	Which recommendations have been fully implemented?
	Which recommendations have been partially implemented?
	Which recommendations have not been implemented at all?
Tetun version:	Tetun version:
2. Rekomendasaun sira ne'e implementa ona ka seidauk?	Etapa ida nebe mak implementa daudaun/hela?
	Rekomendasaun sira nebe mak implementa ona?
	Rekomendasaun sira nebe mak seidauk implementa hotu?
	Rekomendasaun sira nebe mak seidauk implementa

Questions	Sub-questions
If the respondent stated that the recommendations had not been implemented, he/she was asked: what were the main barriers implementing the recommendations?	Prompts for main barriers: Financial? Political, Bureaucratic support? Infrastructure? Staffing? Transport? Community support? Any other reasons?
Tetun version: Karik responden hatan katak sedauk implementa maka pergunta tuir mai ne'e sei hato ba sira: Fatores saida deit mak konsidera nudar bareiras ba implemetasaun rekomendasaun sira ne'e?)	Tetun version: Karik fatores sira tuir mai ne'e mak sai hanesan bareiras ba implementasaun: Financiamento?, Politika?, Suporta birokrasia?, Infrastrutura?, Staffing?, Transporte?, Suporta husi komunidade? Rasaun seluk?

2.5.5 Analysis of Interview Data

The data collection involved audio recordings, interview transcripts and interviewer notes. To assure the confidentiality and protection of the interviewees, the interview recordings were treated as confidential research records and interview participants were assigned a unique study ID.

A thematic analysis was performed "to identify, to analyse, and to report themes within data" (Braun 2006 p.77-110). The analysis consisted of four parts: interview debriefing, transcript coding, data display, and interpretation, comparable to a method used by Bedos and colleagues (Bedos et al 2013). The debriefings were conducted by the interviewer and a research supervisor, with the aim of reviewing the main findings, identifying emerging hypotheses and preparing for the next interview. The transcripts were coded in Microsoft Word. A data analysis document was created with the key themes identified during debriefings listed as sub-headings. Text was then cut from interview transcripts and pasted under relevant theme headings. New headings were created throughout this process. After systematically coding each interview transcript the themes and their corresponding passages were assessed, and over-arching themes were identified. An analytic matrix was then used to organise the coded text into main themes and sub-themes (Miles 1994).

In order to enhance the integrity and accuracy of the themes the researcher's supervisor (SB) checked and validated the analysis. Where there was disagreement the researcher and supervisor discussed their interpretations of the data, and themes until agreement was attained.

2.6 Epidemiological Survey of the Oral Health of Children Living in Dili

This component of the study was based upon the 2002 National Oral Health Survey report (AusAID 2002). The 2014 study sought to assess the current oral health status of children aged 6-17 years old in Dili, Timor-Leste. Since the 2002 survey there had been little effort to improve the oral health status of children in Dili. The intention was to gather current information on the oral health of children in Dili to inform oral health policies and plans for the district and the country. The study was supported by the government of Timor-Leste through the Ministry of Health and the Ministry of Education, the East Timor Consulate in Tasmania and the Timor-Leste Dental Association, as well as the University of Tasmania. Funding for the survey was provided by Menzies Research Institute of Tasmania, the School of Medicine of the University of Tasmania, Timor-Leste Consulate in Hobart, Tasmania and the Timor-Leste government.

2.6.1 Aims of the Epidemiological Survey

The survey aimed to develop an oral health profile of children aged 6 to 17 years in the district of Dili, Timor-Leste. Additionally, the study set out to describe the oral health status of children living in Dili in 2014 compared to 2002. There were two components to the epidemiological survey: an oral health behaviours questionnaire and an oral examination.

Objectives of the Oral Health Behaviours Questionnaire

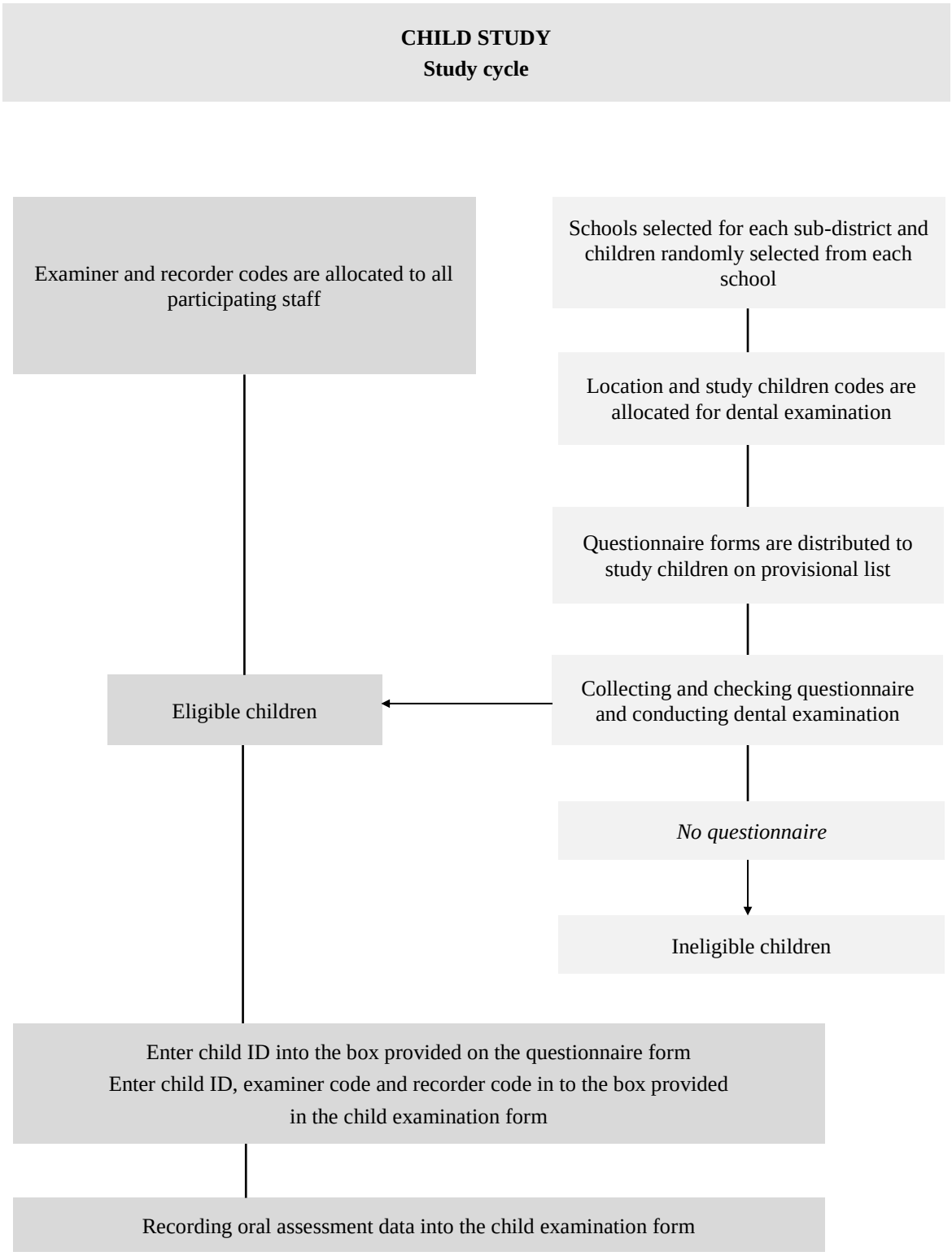
The oral health questionnaire sought to collect information on oral health behaviours (e.g. tooth brushing), oral health experiences (e.g. toothache) and dental visiting patterns (e.g. frequency of dentist visits, reason for last visit).

Objectives of the Oral Examination

The oral examination sought to collect information on:

- The prevalence of decayed primary and permanent teeth
- The prevalence of missing primary and permanent teeth
- The prevalence of filled primary and permanent teeth
- The mean number of decayed, missing and filled primary and permanent teeth (dmft/DMFT)
- The prevalence of dental calculus
- The prevalence of gingival bleeding

Figure 2.1. Child study plan 2014



2.6.2 Epidemiological Survey Methods

Target Population

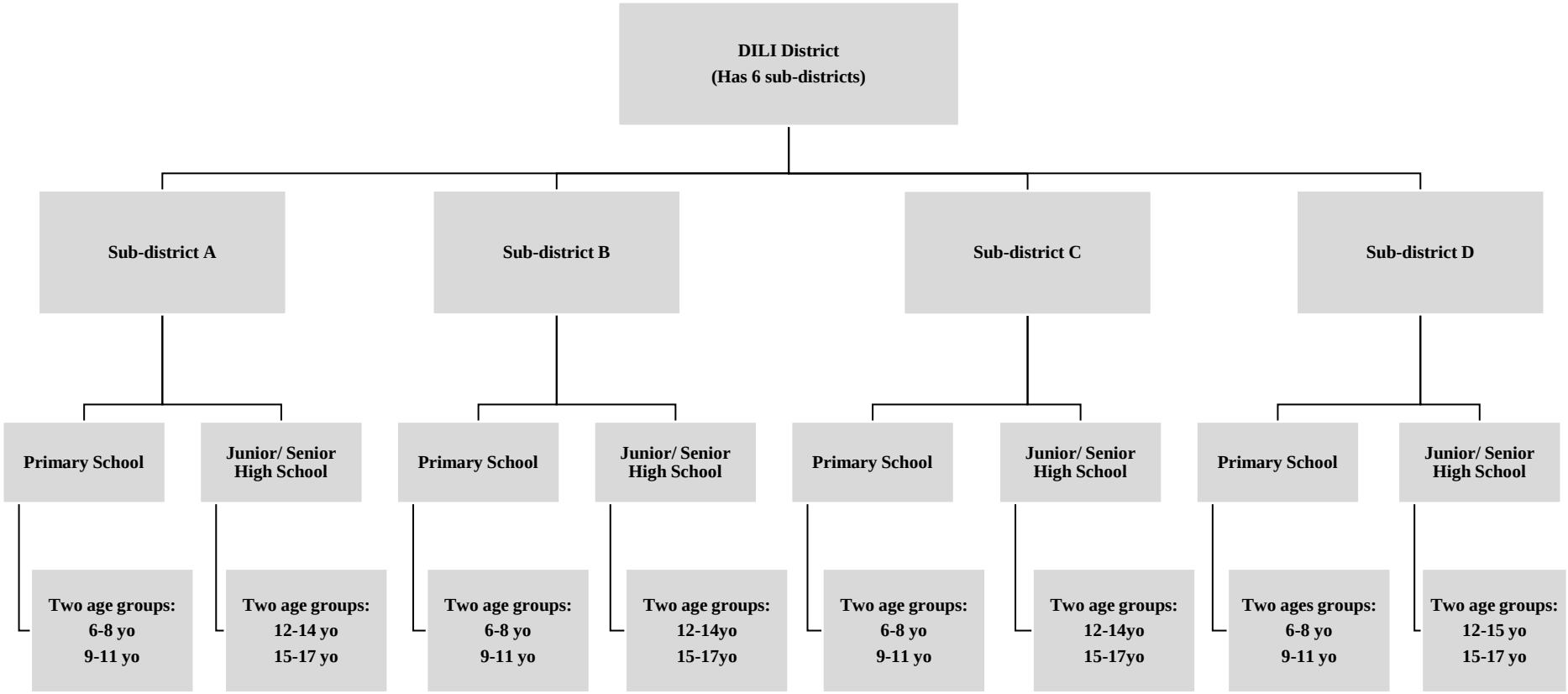
Students aged 6-17 years enrolled in primary schools and in junior and senior high schools in the district of Dili were targeted and were invited to participate in the survey.

Four sub-districts (Cristo Rei, Dom Aleixo, Vera Cruz and Metinaro) were randomly selected among the six sub-districts of Dili. Within each subdistrict all the schools were identified through a list provided by the Direcao Encino Basico e Encino Secudario, Ministerio da Educacao de Timor-Leste (Directorate of Basic and Secondary Education, Ministry of Education, Timor-Leste). The number of schools selected to participate was proportional to the population size of the sub-district (**Error! Reference source not found.**).We sought to invite equal numbers of primary (6-11 years old), junior (12-14 years old) and senior high school students (15-17 years old).

Table 2.2. Population size percentage of population, number of participated schools and percentage of schools among total selected schools

Sub-district	Population size	Percentage of total population across all 4 sub-districts	Number of schools selected to participate	Percentage of schools among total 40 schools selected
Cristo Rei	54,936	27.6%	13	32.5%
Dom Aleixo	105,154	52.9%	18	45.0%
Metinaro	4,727	2.4%	3	7.5%
Vera Cruz	34,015	17.1%	7	17.5%

Figure 2.2. Diagram of survey design



Sample Size and Power

The sample size required for the 2014 survey was calculated based on a hypothesised 25% increase (from 2002 level) in the prevalence of dental caries in the permanent dentition, from 48.3% to 60.4%. As the 2002 survey recruited 201 children, it was calculated that a sample of 600 children for the 2014 group would result in >80% power at alpha 0.05 for the investigation of the change in prevalence of decay in permanent teeth. As the 2002 survey had a 77.5% response rate for child participants, we calculated 800 children would need to be invited to recruit approximately 620 participants.

Recruitment of Participants

Prior to conducting the survey, the survey team (four dentists and five dental nurses) approached the principals of selected schools in Dili to explain to them the aims of the study and to seek their students' participation in the study. The next step was to write a formal letter to the principals to ask for their permission and to seek participation of their students in the study.

All schools invited to participate in the study accepted the invitation. Participating schools provided a list of students in each year to the lead investigator. The researcher then randomly selected equal numbers of children from each of the three age groups (6-11 years, 12-14 years and 15-17 years).

The recruitment of children took place within each participating school. Children who were randomly selected to participate were given an invitation to participate (appendix 2) and Study Information Sheet (appendix 4) and were requested to give these to their parent/guardian to read. The Study Information Sheet informed the students and their parents/carers about the study background, aims, method, the consent process and the requirements of participation. The lead investigator and the members of survey team were not involved in recruiting the participants. A dental staff member or school teacher who had no affiliation to the survey was asked to conduct the recruitment of participants. This was to address issues of power relations and to ensure that participants felt that their participation in the research was voluntary. The participants were free to decline participation without giving a reason. A written consent form

(appendix 12) signed by the child's parent/carer was required prior to the questionnaire and dental epidemiological examination.

Epidemiological Survey Oral Health Behaviours Questionnaire

Data were collected using an oral health behaviours questionnaire (appendix 9) and an oral examination (appendix 11). The same questionnaire used in the 2002 National Oral Health Survey (AusAID 2002) was used to gather information on socio demographics and oral health behaviours. This questionnaire was developed by the researchers from the Australian Research Centre for Population Oral Health, the University of Adelaide. Permission to use the questionnaire was obtained from Professor Kaye Roberts-Thomson. The questionnaire was designed in English then translated into Tetum (Timor-Leste official language). The questionnaire obtained information on tooth brushing, use of toothpaste, appearance of the teeth, toothache, time since last dental visit, reason for last visit and treatment received. As the questionnaire was almost identical to the questionnaire used in the 2002 study, it was not piloted in formal sense.

Oral Health Behaviours Questionnaire Data Collection

A study information and an invitation letter were given to the principals of the selected schools and then were distributed to the parents a week before data collection. The parents/carers of invited students completed the oral health behaviours questionnaire prior to clinical examination. The older children (15-17 years old) who were not accompanied by their parents/carers self-completed the questionnaire. For those who were illiterate, the questionnaire was orally administered by a school teacher who had no affiliation with the illiterate parents/carers who completed the questionnaire. Each participant returned the questionnaire to the dental nurse or dentist before proceeding to clinical examination.

Oral Examination

The oral examination was performed to collect clinical data on dental caries, missing teeth, filled teeth and periodontal disease (using the presence/absence of gingivitis and calculus as markers of periodontal disease). The dental examination was conducted within schools (in classrooms) following completion of the survey by their parents. Children were seated in a proclined position and the examination was conducted in natural sunlight (with no additional lighting). The dental status of each participant was

identified using a set of diagnostic instruments, a dental mirror, a probe and tweezers, dental gauze, cotton pellet and cotton roll. The examination collected information on teeth present, caries prevalence and severity, number of fillings, oral hygiene and gingival condition. The dental status of participants was scored using dmft indices for deciduous teeth and DMFT indices for permanent teeth, according to the criteria of the World Health Organization. In addition, periodontal status was assessed using calculus and bleeding indices. There was no treatment provided to the students.

The codes for the dentition status of primary and permanent teeth are given in **Error! Reference source not found.**.

Table 2.3. Criteria for scoring dentitiona status of primary and permanent teeth according to World Health Organization 1997 (Parkash et al. 2004)

Primary Teeth (score)	Permanent Teeth (score)	Condition/Status*
A	0	Sound
B	1	Decayed
C	2	Filling with decay
D	3	Filling with no decay
E	4	Missing due to caries
-	5	Missing due to any other reason
F	6	Fissure sealant/varnish
T	7	Trauma
-	U	Un-erupted tooth
-	X	Not recorded

**Criteria for diagnosis*

Definitions

- 0 (A). Sound Crown: A crown is recorded as sound if it shows no evidence of treated or untreated clinical caries.
- 1 (B). Decayed Crown: Caries is recorded as present when a lesion in a pit or fissure, or on a smooth tooth surface, has an unmistakable cavity, undermined enamel, or a detectably softened of floor or wall.

- 2 (C). Filled Crown, with decay: A crown is considered filled, with decay, when it has one or more permanent restorations and one or more area that is decayed.
- 3 (D). Filled Crown, with no decay: A crown is considered filled, without decay, when one or more permanent restorations are present and there is no caries anywhere on the crown.
- 4 (E). Missing tooth, as a result of caries: This code is used for permanent and or primary teeth that have been extracted because of caries and is recorded under coronal status.
- 5 (-). Permanent tooth missing, for any other reason: This code is used for permanent teeth judge to be absent congenitally, or extracted for orthodontic reasons or because of periodontal disease, trauma, etc.

Both letters and numbers in table 7 are used for recording dentition status of primary and permanent teeth.

Primary teeth or decayed, missing and filled teeth index (dmft)

- The d-component includes all teeth with codes B or C.
- The m-component includes all teeth with code E.
- The f-component includes only teeth with code D.

Permanent teeth or Decayed, Missing and Filled Teeth Index (DMFT)

- The D-component includes all teeth with codes 1 or 2.
- The M-component comprises teeth with code 4.
- The F-component includes only teeth with code 3.

The code for recording periodontal status (gingival bleeding and dental calculus) is described below:

Gingival Assessment

The buccal and mesial sites of the teeth 16, 11, 26, 36, 31 and 46 were assessed. The CPITN probe was inserted no more 2 mm into the gingival sulcus, starting distal line angle on the buccal surface and then moved gently toward the mesial interproximal area. Each tooth was recorded a score: 0: no gingival bleeding occurred when moving

the probe; 1: gingival bleeding occurred at any site when moving probe; Y: could not be assessed or missing.

Calculus Assessment

The buccal and lingual surfaces of the teeth 16, 11, 26, 36, 31 and 46 were assessed. Examiners observed and used the CPITN probe to feel the buccal and lingual aspects of each tooth to determine the presence of calculus either sub or supra-gingival. Each tooth was recorded a score: 0: calculus not detected at any supra or sub-gingival site using visual or tactile sense; 1: calculus detected at one or more supra or sub-gingival sites using visual or tactile sense; Y: cannot be assessed or missing.

Examiner and Recorder Training

Prior to dental examination, a calibration and standardisation training was carried out for the survey team (four dentists and five dental nurses). The training took place during one week at Guido Valadares National Hospital. Over the first three days the main researcher provided initial training to the survey team using a Powerpoint presentation. The training materials were delivered in Tetum (Timor-Leste's native language). Detailed information on the study methods and the importance of obtaining accurate data was provided to the study team. Over the subsequent two days the training was led by Associate Professor Leonard Crocombe: firstly at the hospital complex, then at a primary school in Dili. Training exercises were conducted to assess the consistency of the examiners.

Standardisation and Calibration Program

The standardisation program, supervised by Associate Professor Leonard Crocombe, took place in a public primary school in Dili. Following the program, a period of review was conducted to ensure that all survey team members had the same perception of the program.

Calibration is a comparison of measurements carried out among the examiners, while standardisation is the process of developing and implementing dental examination and data recording standard. Approximately 10% of the study participants were selected for a calibration session. The data collected during calibration was examined for inter-examiner reliability.

The calibration and standardisation program was developed by Associate Professor Crocombe and the lead researcher based on a similar program conducted during the 2002 oral health survey. This program was modified to suit the capabilities of the 2014 survey team.

Inter Examiner Reliability

A sub-sample of 69 children (10.5% of the total 655 oral examinations) was randomly selected to collect data for inter-examiner reliability. Prior to the calibration session, the examiners and the recorders (dental nurses) were trained in the hospital compound (HNGV) in Dili by the PhD candidate (LBS). All the examiners were in the same room for the calibration session and they did not see each other's results.

Inter-rater agreement (between dental health professionals and the gold standard assessor) was assessed using Krippendorff's alpha. Data with agreement co-efficients lower than $\alpha = 0.80$ are considered to have tentative agreement, while coefficients of $\alpha < 0.667$ are considered to have poor agreement (Krippendorff 2004).

The overall mean Krippendorff alpha was 0.93, with a range of 0.65 to 1.00 (**Error! Reference source not found.**). Two teeth were below $\alpha \geq 0.80$ for inter-rater reliability and one of these, UL5, was below the critical threshold of $\alpha < 0.667$.

Table 2.4. Inter-rater reliability analyses, Krippendorff alphas by tooth

Item	Observers	Pairs	α	95% CI
Calculus	2	69	.88	.76, .97
Bleeding	2	69	.94	.85, 1.00
Tooth				
UR1	3	205	.86	.67, 1.00
UR2	3	199	.71	.33, 1.00
UR3	3	204	1.00	1.00, 1.00
UR4	3	201	1.00	1.00, 1.00
UR5	3	207	.97	.91, 1.00
UR6	3	198	.94	.85, 1.00
UR7	3	120	.93	.84, 1.00
UL1	3	207	.91	.77, 1.00

Item	Observers	Pairs	α	95% CI
UL2	3	207	.84	.58, 1.00
UL3	3	204	1.00	1.00, 1.00
UL4	3	201	.97	.90, 1.00
UL5	3	204	.65	.45, .81
UL6	3	201	.91	.78, 1.00
UL7	3	120	.91	.74, 1.00
LR1	3	202	.88	.69, 1.00
LR2	3	207	1.00	.00, 1.00
LR3	3	205	.87	.60, 1.00
LR4	3	204	.97	.92, 1.00
LR5	3	198	.93	.84, 1.00
LR6	3	195	.95	.89, 1.00
LR7	3	129	.96	.91, 1.00
LL1	3	201	1.00	1.00, 1.00
LL2	3	205	1.00	0.00, 1.00
LL3	3	207	.87	.60, 1.00
LL4	3	201	.96	.88, 1.00
LL5	3	204	1.00	1.00, 1.00
LL6	3	201	.92	.82, .98
LL7	3	129	1.00	1.00, 1.00

Any disgareement encountered during the calibration session was discussed thoroughly after each examiner made their assessment of the tooth. When the findings contained major discrepancies (e.g. for UR2 and UL5 which had Krippendorff alphas below the critical threshold) the patient was re-examined and disagreements were resolved through discussion between the PhD lead supervisor (LC) and the examiners until the examiners (dentists) obtained the same result.

2.6.3 Analysis of the Oral Health Questionnaire Data and the Oral Examination Data

All questionnaires and oral health examination forms were collected and checked for inaccuracies. The data was entered into an Excel spreadsheet by the lead researcher. This was amalgamated with data on children living in Dili from the 2002 survey and oral examination, kindly provided by Professor Roberts-Thomson.

Statistical Analysis

The study data were analysed using Stata 14 (StataCorp, College Station, Texas) and SPSS version 23 (IBM Corporation, 1989, 2012, Armonk New York). With the exception of the preliminary investigation of age and sex distributions across the surveys, the data were weighted to the 2010 age and gender distribution of children in Dili, based on population numbers reported by the 2010 census (NSD 2011). With the exception of binomial tests, all tests were two-sided and differences were accepted as significant at alpha 0.05 level. Statistical tests relevant to each chapter are reported within the methods of the relevant chapter.

2.7 Development of Oral Health Policy Recommendations

The oral health policy recommendations for the next five years were developed by examining the existing documentation on oral health policy which was relevant to the situation in Timor-Leste and comparing them with the policy recommendations in the 2002 survey. Relevance was determined by the PhD participant's (LBS) knowledge of local culture. Reasons why the 2002 survey recommendations were, or were not implemented, was discovered from the scoping interviews. The current Timor-Leste oral health policies were investigated, followed by recommendations for oral health policies for Timor-Leste taking into account the unique Timor-Leste situation such as the recent baby boom and the limited resources. Relevance of each policy was determined by the PhD participant's (LBS) knowledge of local culture.

2.8 Conclusion

In this chapter I have described the ethical considerations pertinent to the study and detailed the methods of the policy document review, stakeholder interviews, the oral health questionnaire and the oral examination. Each of these components had related but separate study aims and required different data collection methods.

2.9 Postscript

In this chapter I have described the methods used to conduct the study. I explained the components of the research in detail.

Firstly, in the review of policy recommendations of the National Oral Health Survey in 2002, I have shown that the oral health policy recommendations were described and were generally accepted by the Ministry of Health of Timor-Leste. The World Health Organization (WHO) South-East Asia regional recommendations for Member States to include oral health in their national health policies and the Timor-Leste National Health Sector Strategic Plan 2011-2030 were also described. A scoping interview conducted prior to commencing the present study to consult oral health policy stakeholders in Timor-Leste was elucidated. The interview methods, questions and data analysis of the interview were all described.

Secondly, the epidemiological survey of the oral health of children living in Dili was undertaken. In this section I presented the aims and the objectives of the oral health behaviours questionnaire and the oral examination. I have shown that this study targeted 6-17 years old children and that the children recruited from all participating schools accepted the invitation to take part in the study.

Thirdly, I have described the methods of the oral health examination conducted with survey. I have also described the indices used to score participants' dental status as well as the indices for scoring calculus and gingival bleeding. This chapter also described the examiner and recorder training and the standardisation and calibration program.

Chapter 3

Summary of the Results of the Epidemiological Survey and Oral Examination

3.1 Preface

In this chapter, the results of the 2014 epidemiological survey of school children in four Dili sub-districts are reported. The results presented in this chapter cover the two components of the oral health epidemiological survey: 1) Results of the oral health behaviours questionnaire-demographic characteristics, tooth brushing, history of dental visiting and treatments received; 2) Results of oral examinations: calculus status, gum bleeding and the scoring of teeth to determine the number of decayed, missing or filled deciduous and permanent teeth. Further comparative analyses of this data are presented in subsequent chapters.

3.2 Aim

To describe the demographic characteristics, oral health behaviours and oral health status of children who participated in the 2014 survey.

3.3 Methods

3.3.1 Study Design

A cross-sectional epidemiological survey of the oral health of Dili's children.

3.3.2 Study Population

Children aged 6-17 years enrolled in primary, junior high schools and senior high schools in the district of Dili in 2002 and 2014.

3.3.3 Sampling Strategy

The 2014 oral health survey of Dili's children replicated the methods described by Roberts-Thomson and colleagues in the AusAID report (AusAID 2002). Four of Dili's

six sub-districts were randomly selected for inclusion: Dom Aleixo, Cristo Rei, Metinaro and Vera Cruz.

3.3.4 Sample Size

The overall study power calculation was conducted for the comparative analyses described in Chapter 2.

Data from the 2010 Timor-Leste census showed there were 61,300 children aged 6-17 years residing in the Dili region. A total of 800 children were invited to participate and the study recruited 758 children, or approximately 1.2% of children in these age groups living in Dili.

3.3.5 Recruitment

Recruitment took place within 40 schools, with students randomly selected and invited to participate. Equal numbers of children were invited to participate from each of the four age strata (6–8, 9–11, 12–14 and 15–17 years).

Children were provided with a study information sheet and consent form to take home for their parent or guardian to read and complete. All parents/guardians provided written consent for their child to participate.

3.3.6 Participants

Participants were children aged 6 to 17 years who were attending participating schools.

3.3.7 Data collection

A questionnaire was used to collect data on demographics and oral health behaviours. The questions were the same as those used in the 2002 study (AusAID 2002). The questionnaire was designed in English then translated into Tetum (Timor-Leste's official language). The questionnaire obtained information on demographics, tooth brushing, use of toothpaste, time since last dental visit, reason for visit, the type of professional visited and treatment received.

Parents/guardians completed the oral health behaviours questionnaire at home or at the child's school and parents/guardians were invited to accompany their children for the

oral examination. For those who were illiterate, the questionnaire was orally administered by a member of the research team during the school data collection visit.

Oral epidemiological examinations were conducted by dental health professionals (four dentists and five dental nurses) who had completed a five-day training, standardisation and calibration workshop. Reliability of the examiners was assessed among a sub-sample of 69 children against a gold standard examiner. Inter-rater reliability was high (mean Krippendorff's alpha 0.93, range 0.65 to 1.00, with 2 of 28 teeth below the critical value of $\alpha \geq 0.80$). Oral examinations were conducted in school classrooms.

For the oral examinations, children were seated in a proclined position and natural sunlight was used. The examination collected information on the number of teeth present, caries prevalence and severity, oral hygiene and the gingival condition. Children's dental status was scored using the decayed missing and filled teeth index (dmft) for deciduous teeth and permanent teeth (DMFT). In addition, periodontal status was assessed using calculus and bleeding indices (WHO 1997).

3.3.8 Data Analysis

Data from the surveys and oral examinations was entered into a spreadsheet. The data were checked for accuracy and completeness prior to export to IBM SPSS version 23 for data analysis. With the exception of the preliminary investigation of age and sex distributions across the surveys, the data were weighted to the age and gender distribution of children in Dili based on the 2010 census (GOTL 2010).

Data on toothache, avoiding eating and unhappy about appearance of teeth was collected on a Likert scale with the categories: never, hardly ever, sometimes, often and very often. This data was dichotomised for analysis, to never/hardly ever and sometimes/often/very often.

Binomial tests were used to investigate whether the proportion of male children in the survey and oral examinations was equivalent to census data. The data were then weighted and chi-square tests (or Fisher's exact tests where appropriate) were utilised to investigate the proportion of children by age group and sex who reported specific oral health behaviours (e.g. tooth brushing the previous day), visits to dentists, receipt of treatment and oral health status (e.g. the presence of gingival bleeding). One-way analysis of variance

(ANOVA) was used to investigate mean dmft+DMFT by age group. Levene's statistic was used to test homogeneity of variance and Welch's robust test was used to test equality of means, with a post-hoc Games-Howell test used to determine significant differences between age groups for dmft+DMFT. With the exception of the binomial test, all tests were two-sided and differences were accepted as significant at alpha 0.05 level.

3.4 Results

3.4.1 Oral Health Behaviours Questionnaire Results

Of the total 800 children invited to participate, 758 children were recruited for the oral health behviours questionnaire (95% response rate). There were 292 children recruited in Dom Aleixo sub-district, 217 (28.6%) in Cristo Dei, 135 (17.8%) in Vera Cruz and 114 (15.0%) in Metinaro.

The questionnaire sample was balanced across age groups and by sex (Table 3.1). The gender proporions recruited for the questionnaire (51.2% male, 48.8% female) were exactly the same as the gender proportions for children aged 6-17 years in Dili, as reported from the 2010 census (51.2% male, 48.8% female) (NSD 2011).

Table 3.1. Sex and age distribution (unweighted data) 2014 Oral Health Survey

	Oral Health Behaviours Questionnaire (n = 758)				
Sex	**Male**		**Female**		**Total**
Age	n	%	n	%	n
6–8 years old	90	48.4	96	51.6	212
9–11 years old	105	53.3	92	46.7	186
12–14 years old	97	53.9	83	46.1	163
15–17 years old	96	49.2	99	50.8	197
Total	*388*	*51.2*	*370*	*48.8*	*758*

Just over half (54.3%) of the children had mothers who had a senior high school or more advanced level of education and 64.8% had a father with an equivalent education level (Table 3.2). However, nearly one in 10 mothers (9.5%) and 6.0% of fathers had not participated in any formal education.

Table 3.2. Education level of survey participants' parents (data weighted to Dili 2010 Census population)

Education Level Of Parents	Mother n (%)	Father n (%)
No schooling	72 (9.5)	45 (6.0)
Elementary school	152 (20.1)	101 (13.4)
Junior high school	123 (16.2)	120 (15.8)
Senior high school	296 (39.1)	309 (40.8)
College or tertiary	115 (15.2)	182 (24.0)
Total	***758 (100.0)***	***758 (100.0)***

The largest occupation group for mothers was home duties (51.2%) and for fathers, professional or administration work (41.1%). Nearly a third (30.5%) of fathers worked either as farmers or manual labourers (Table 3.3).

Table 3.3. Occupation of survey participants' parents (data weighted to Dili 2010 Census population)

Occupation of Parents	Mother n (%)	Father n (%)
Farmer	69 (9.2)	154 (20.3)
Manual worker	9 (1.2)	77 (10.2)
Professional or administrative	170 (22.5)	312 (41.1)
Private business	94 (12.4)	134 (17.6)
Home duties and other	389 (51.3)	67 (8.8)
Other	26 (3.5)	15 (1.9)
Total	***758 (100.0)***	***758 (100.0)***

A majority (78.3%) of children lived in a home owned by their parents and only 3.3% lived in rental accommodation. The 18.4% who lived in a either a jointly owned home or shared accommodation reflects intergenerational household composition (Table 3.4).

Table 3.4. Accommodation ownership (data weighted to Dili 2010 Census population)

Accommodation	n = 758 n (%)
Own home	593 (78.3)
Jointly owned home	121 (16.0)
Shared accommodation	18 (2.4)
Rental accommodation	25 (3.3)
Total	***758 (100.0)***

Nearly all of the participants (96.7%) reported they brushed their teeth the day prior to survey and 95.2% reported that they generally brushed their teeth at least once per day (Table 3.5). Toothpaste was regularly used by 98.5% and 62.4% reported that they sometimes to often used toothpicks to their clean teeth.

Table 3.5. Tooth cleaning behaviours (data weighted to Dili 2010 Census population)

Tooth Cleaning Behaviours	n = 758 n (%)
Brushed teeth yesterday	733 (96.7)
Use of toothpaste (generally)	747 (98.5)
Frequency of tooth brushing	
Once daily or more often	722 (95.2)
Several times per week	10 (1.3)
Weekly	23 (3.1)
Missing	3 (0.4)
Frequency of using tooth picks	
Often	98 (12.9)
Sometimes	375 (49.5)
Never	285 (37.6)

Despite 95.2% of children reporting daily tooth brushing, tooth pain was common (Table 3.6). Approximately one-third of children reported toothache (36.8%) or avoiding eating due to tooth pain (30.9%) sometimes, often or very often during the 12 months prior to survey participation. An equivalent proportion (33.3%) reported that they were unhappy about the appearance of their teeth.

Table 3.6. Oral health experiences during the past 12 months (data weighted to Dili 2010 Census population)

Reported Oral Health	n = 758 n (%)
Toothache During The Past 12 Months	
Very often	40 (5.2)
Often	53 (7.0)
Sometimes	186 (24.6)
Hardly ever	139 (18.3)
Never	276 (36.4)
Cannot remember	64 (8.5)
Toothache (sometimes to very often)	*279 (36.8)*
Avoid Eating Due To Tooth Pain During The Past 12 Months	
Very often	14 (1.9)
Often	40 (5.2)
Sometimes	180 (23.8)
Hardly ever	168 (22.2)
Never	274 (36.2)
Cannot remember	81 (10.7)
Avoid eating due to tooth pain (sometimes to very often)	*234 (30.9)*
Unhappy About Appearance Of Teeth During The Past 12 Months	
Very often	26 (3.4)
Often	43 (5.7)
Sometimes	184 (24.2)
Hardly ever	171 (22.6)
Never	272 (35.9)
Cannot remember	62 (8.2)
Unhappy about appearance of teeth (sometimes to very often)	*252 (33.3)*

Fewer than half (44.6%) of the respondents had ever visited a dentist and only 181 (23.8%) had visited a dentist during the past 12 months (Table 3.7). Among the 337 children who had previously visited a dentist, 78.6% had made the appointment due to pain, decay, bleeding or trauma. An examination and prescription was the most

common (40.7%) treatment received during the last dental visit among the 337 children who had ever visited a dentist, while an extraction was the second most common (29.7%) treatment received.

Table 3.7 Dental visits and treatments received at last visit (data weighted to Dili 2010 Census population)

Dental Visits and Treatments	**n = 758 n (%)**
Never visited a dentist	421 (55.4)
Ever visited a dentist	337 (44.6)
Visited a dentist during the past 12 months	181 (23.8)

Reason For Last Dental Visit	**n = 337***
Check-up	32 (9.4)
Pain, decay, bleeding or trauma	265 (78.6)
Unable to recall	40 (12.0)

Treatment Received At Last Dental Visit	**n = 337***
Exam and prescription	137 (40.7)
Cleaning scaling	23 (6.9)
Extraction	100 (29.7)
Filling	25 (7.4)
Other	11 (3.2)
Unable to recall	40 (12.0)

**n = 337 as 421 children who had never visited a dentist were excluded from these percentage calculations*

3.4.2 Oral Health Behaviours Questionnaire Results by Age and Sex

A greater proportion of females reported brushing their teeth the day prior to survey ($\chi^2(1) = 8.63$, $p = 0.003$). A slightly smaller, but statistically significant, proportion of children aged 6-8 years reported using toothpaste compared to the other age groups (Fisher's exact $p = 0.02$). There was also an association between age group and the use

of toothpicks ($\chi^2(3) = 38.8$, $p < 0.001$), with a greater proportion of children in older age groups reporting the use of toothpicks (Table 3.8).

Table 3.8. Association between oral health behaviours and demographic characteristics (data weighted to Dili 2010 Census population)

Sub-Group	**Brushed Teeth Yesterday**		**Uses Toothpaste**		**Uses Toothpicks**	
Age group	**%**	***p***	**%**	***p***	**%**	***p***
6-8 years	94.7		98.0		50.0	
9-11 years	96.8	0.12	100.0	0.02	55.3	< 0.001
12-14 years	96.4		100.0		69.3	
15-17 years	99.0		100.0		77.0	
Sex						
Males	94.8	0.003	99.7	0.29	60.3	0.20
Females	98.6		99.2		64.9	

***Note**: Weighting of data results in slight changes in the number of participants in each age group and by sex across each bivariate test. To avoid confusion, percentages only are reported.*

There were no significant associations between demographics and toothache, avoiding eating due to tooth pain or dissatisfaction with the appearance of teeth (Table 3.9).

Table 3.9. Association between oral health experiences and demographic characteristics (data weighted to Dili 2010 Census population)

Sub-group	Toothache Sometimes to Very Often		Avoids Eating Sometimes to Very Often		Unhappy About Appearance of Teeth	
Age group	**%**	***p***	**%**	***p***	**%**	***p***
6-8 years	42.7		32.6		36.2	
9-11 years	40.9	0.74	32.7	0.71	35.5	0.44
12-14 years	40.4		35.4		41.1	
15-17 years	36.7		37.7		32.6	
Sex						
Males	38.5	0.34	35.0	0.84	36.8	0.76
Females	42.1		34.2		35.7	

***Note**: Weighting of data results in slight changes in the number of participants in each age group and by sex across each bivariate test. To avoid confusion, percentages only are reported.*

There was an association between age and ever visiting a dentist, with a larger proportion of children in the older age groups reporting that they had visited a dentist at some point in their life ($\chi^2(3) = 14.5$, $p = 0.002$) (Table 3.10). There were no other associations between dental visits and either age group or gender.

Table 3.10. Association between demographic characteristics and dental visits, reasons for visits and treatment received at last visit (data weighted to Dili 2010 Census population)

Sub-group	Ever Visited a Dentist		Last Visit to a Dentist Due to a Problem (Pain, Decay, Bleeding, Trauma)		Prescription or Extraction At Last Visit	
Age group	**%**	***p***	**%**	***p***	**%**	***p***
6-8 years	40.6		89.3		88.0	
9-11 years	35.6	0.002	85.9	0.63	84.1	0.06
12-14 years	51.2		88.1		77.9	
15-17 years	51.8		92.3		72.2	

Sub-group Sex	Ever Visited a Dentist		Last Visit to a Dentist Due to a Problem (Pain, Decay, Bleeding, Trauma)		Prescription or Extraction At Last Visit	
Males	43.9	0.74	87.8	0.44	78.9	0.62
Females	45.1		90.6		81.2	

Note: *Those who had never visited a dentist and those who did not remember the treatment they received at their last visit excluded from second and third columns of this table. Weighting of data results in slight changes in the number of participants in each age group and by sex across each bivariate test. To avoid confusion, percentages only are reported.*

3.4.3 Oral Examination Results

There were 655 children who participated in the oral examination (82% response rate). The lower rate of participation in the oral examination compared to the oral health behaviours questionnaire (n = 758) was due to some children being absent from school on the day of the oral examination and some children being unwilling to participate in the oral examination.

Like the questionnaire sample, the oral examination sub-sample was balanced across age groups and by sex (Table 3.11). The gender proportions for the oral examination component (51.0% male, 49.0% females) were not significantly different (p = 0.47) from the 2010 census.

Table 3.11. Sex and age distribution 2014 Oral Examination (unweighted data)

	Oral Examination Dili (n = 655)				
Sex	**Male**		**Female**		**Total**
Age	n	%	n	%	n
6–8 years old	78	50.0	78	50.0	156
9–11 years old	79	48.5	84	51.5	163
12–14 years old	77	46.4	89	53.6	166
15–17 years old	87	51.2	83	48.8	170
Total	*321*	*51.0*	*334*	*49.0*	*655*

There was no association between sex and participation in the examination, with 86.1% of boys and 86.8% of girls who completed the questionnaire also having an examination ($\chi^2(1) = 0.07$, $p = 0.79$). However, there was an association between age and participation in the examination, with a larger proportion of 12-14 year olds participating compared to other groups ($\chi^2(3) = 8.56$, $p = 0.04$) (Table 3.12).

Table 3.12. Percentage of oral examination participants among all questionnaire participants, by age group (unweighted data)

Age Group	Percentage Of Children Who Participated In Oral Examination Among All Participants n = 655 n (%)	*p*-value
6-8 years	156 (83.9)	0.04
9-11 years	163 (82.7)	
12-14 years	166 (92.2)	
15-17 years	170 (87.2)	

Nearly two-thirds of the oral examination participants had gingival bleeding (n = 423, 64.6%) and more than half (n = 374, 57.1%) had calculus (Table 3.13). The mean number of decayed, missing or filled teeth was 3.5 among children aged 6-11 years. A large proportion (83.3%) of children aged 6-8 years had one or more decayed deciduous teeth. Among those aged 9-11 years the proportion of decayed deciduous teeth was 57.7%, with this lower proportion of decayed teeth due to exfoliation of deciduous teeth between 6 and 8 years of age. Fewer than 5% of children had either missing or filled deciduous teeth.

Table 3.13. Gingival bleeding and calculus (data weighted to Dili 2010 Census population)

Indicator	n = 655 n (%)
Prevalence of gingival bleeding	423 (64.6)
Extent of sites with gingival bleeding (mean % of sites)	28.1 (27.6)
Prevalence of calculus	374 (57.1)
Extent of sites with calculus (mean % of sites)	25.4 (28.1)

The prevalence of decay (83.3%) in deciduous teeth and the mean number of deciduous teeth with decay (4.7) was highest among children aged 6-8 years (Table 3-14). While 17.4% of 6-8 year olds had missing deciduous teeth, only 3.8% of children in this age group had one or more fillings. Mean dmft was 5.1 in 6-8 year olds and 2.2 among 9-11 year olds.

Table 3-14. Decayed (d), missing (m), filled (f) primary teeth and dmft in children aged 6-11 years (data weighted to Dili 2010 Census population)

Deciduous Teeth	% or Mean (SD)
Prevalence Of Decay (D)	
6–8 years old	83.3
9–11 years old	57.7
Mean number of decayed teeth (d) in 6-8 year olds	4.7 (4.0)
Mean number of decayed teeth (d) in 9-11 year olds	1.9 (2.4)
Prevalence Of Missing Teeth (M)	
6–8 years old	17.4
9–11 years old	11.7
Mean number of missing teeth (d) in 6-8 year olds	0.4 (1.0)
Mean number of missing teeth (d) in 9-11 year olds	0.2 (0.7)
Prevalence Of Filled Teeth (F)	
6–8 years old	3.8
9–11 years old	2.5
Mean number of filled teeth (d) in 6-8 year olds	0.05 (0.2)
Mean number of filled teeth (d) in 9-11 year olds	0.04 (0.3)
Mean dmft in 6-8 year olds	5.1 (4.1)
Mean dmft in 9-11 year olds	2.2 (2.5)

***Note**: Weighting of data results in slight changes in the number of participants in each age group and by sex. To avoid confusion, percentages only are reported.*

The prevalence of decay in the permanent teeth was highest among children aged 15-17 years (87.0%) (Table 3.15). Despite the high prevalence of decay, only 3.7% of children aged 12-14 years and 5.3% of children aged 15-17 years had one or more filled

teeth. Mean DMFT was 2.9 in those aged 12-14 years and 3.4 among children aged 15-17 years.

Table 3.15 Decayed (D), missing (M), filled (F) permanent teeth and DMFT in children aged 12-17 years (data weighted to Dili 2010 Census population)

Permanent Teeth	% or Mean (SD)
Prevalence of decay (D)	
12–14 years old	79.5
15-17 years old	87.0
Mean number of decayed teeth (d) in 12–14 year olds	2.6 (2.2)
Mean number of decayed teeth (d) in 15-17 year olds	3.0 (2.7)
Prevalence of missing teeth (M)	
12–14 years old	13.8
15-17 years old	14.7
Mean number of missing teeth (d) in 12-14 year olds	0.2 (0.6)
Mean number of missing teeth (d) in 15-17 year olds	0.3 (0.8)
Prevalence Of Filled Teeth (F)	
12–14 years old	3.7
15-17 years old	5.3
Mean number of filled teeth (d) in 12-14 year olds	0.1 (0.5)
Mean number of filled teeth (d) in 15-17 year olds	0.1 (0.5)
Mean DMFT in 12-14 year olds	2.9 (2.6)
Mean DMFT in 15-17 year olds	3.4 (3.1)

Note: *Weighting of data results in slight changes in the number of participants in each age group and by sex. To avoid confusion, percentages only are reported.*

Overall mean dmft (deciduous teeth) + DMFT (permanent teeth) was 3.5 (SD 3.4). The highest mean dmft+DMFT was found among children aged 6-8 years (**Table 3.16**) ($F_{(3, 359)} = 22.5$, $p < 0.001$). The post-hoc Games-Howell test indicated there was a significant difference in mean dmft+DMFT between children aged 6-8 and all other

age groups (all $p < 0.001$). There was no significant difference between the 9-11 years age group and the 12-14 years group ($p = 0.10$) or between the 12-14 years group and the 15-17 years group ($p = 0.32$).

Table 3.16 Mean dmft+DMFT by age group (data weighted to Dili 2010 Census population)

Age group	n	Mean dmft+DMFT	95% CI
6–8 years old	184	5.1	4.5, 5.7
9–11 years old	161	2.2	1.8, 2.6
12–14 years old	141	2.9	2.4, 3.3
15-17 years old	170	3.4	2.9, 3.9

3.5 Conclusion

The results of oral health behaviours questionnaire and oral examination indicate a majority of children brush their teeth regularly (with 96.7% of children reporting that they brushed their teeth the day prior to the questionnaire) and use toothpaste (98.5%). However, despite this reported high level of oral hygiene, more than one-third (46.8%) experienced toothache sometimes to very often and nearly one-third (30.9%) avoid eating sometimes to very often due to tooth pain.

More than half of the children (55.4%) surveyed had never visited a dentist, which explains the low number of filled deciduous teeth (mean of 0.05 among children 6-8 years and 0.04 among those 9-11 years) and permanent teeth (0.1 among those aged 12-14 years and 15-17 years). Yet decay was highly prevalent in both deciduous teeth (83.3% among those 6-8 years and 57.7% in those aged 9-11 years) and permanent teeth (79.5% in children aged 12-14 years and 87.0% in those aged 15-17 years). This suggests a substantial gap between the level of need for dental care among Dili's children, and the level of dental care that they are currently receiving.

3.6 Postscript

In this chapter I have presented the results of the epidemiological survey of the oral health of Dili's children in 2014. I have presented the results of self-reported oral health

behaviours and the results of oral health examinations conducted by trained examiners. In the next chapter I present comparative analyses of my 2014 research and the 2002 oral health survey.

Chapter 4

Changes in the Oral Health Status of the Children of Dili, Timor-Leste, between 2002 and 2014

4.1 Preface

In the previous chapter, I presented the results of the epidemiological survey of the oral health of children living in Dili in 2014. In this chapter, a comparison of the prevalence and mean numbers of dmft, DMFT and dmft+DMFT between the 2014 and 2002 surveys is presented. The prevalence of, and extent of sites with, gingival bleeding and calculus in 2014 compared to 2002 are also presented. The text that follows has been publish: Babo Soares LFB, Allen P, Kingi J, Roberts-Thomson K, Bettiol S, Crocombe LA. (2016) Changes in the oral health of the children of Dili, Timor Leste, between 2002 and 2014. *Rural and Remote Health*. 16: 3853.

4.2 Introduction

Oral health is essential for good general health (FDI 2015). Poor oral health is linked with absence from school and work, affects nutrition and diet, and is associated with social stigma and psychological issues (FDI 2015). Yet, approximately 90% of the world's population (3.9 billion people) experience oral diseases (FDI 2015); Beaglehole et al 2009). Preventing and managing oral health problems are a major unmet need in developing economies due to limited resources for dental services (Petersen2005). People from developing economies are increasingly susceptible to dental problems due to an increasing availability of sugar (Popkin 2006), inadequate exposure to fluoride (Petersen et al 2005) and limited oral health education and promotion (Watt 2005).

Timor-Leste is Asia's most recently established nation (Saikia et al 2011) after having undergone a United Nations-sanctioned referendum which voted for independence in 1999. It occupies the eastern half of the island of Timor, located north of Australia (Macaulay 2003). After the referendum, a campaign by Indonesian military and local militia destroyed 70% of the infrastructure and displaced three-quarters of the

population (Chopra 2002). Timor-Leste is undergoing a baby boom with the population expected to triple between 2005 and 2050 (UN Secretariat 2007). The population of Timor-Leste was 1.2 million in 2010 (United Nations 2010), of which 234,331 persons lived in the capital Dili (GOTL 2010). Children under 14 years of age are estimated to contribute to approximately 45% of the total population by 2020 (Saikia et al 2011). The nation is one of the poorer countries in South-East Asia and in the world (Saikia et al 2011), with a human development index of 128 (UN-HDR 2014). Food security is a problem in Timor-Leste, being ranked third in the world for chronic malnutrition in children (WHO 1997).

In 2002 AusAID (now the Australian Department of Foreign Affairs and Trade) dental staff in Timor-Leste and the Australian Research Centre for Population Oral Health at the University of Adelaide, completed a National Oral Health Survey of Timor-Leste with the aim of developing a national oral health profile. The information attained from the study was used to inform government planning and policy making (AusAID 2002). The study found that dental caries experience was highly prevalent in the primary and permanent teeth of children and was largely present as untreated decayed teeth (AusAID 2002).

This paper reports on the oral health status of children in Dili in 2014 and compares them with the oral health status of Dili children in 2002, so that the change in the population oral health in children in Dili can be ascertained. The study intends to inform policies aimed at improving the oral health outcomes of children in Dili and Timor-Leste. The hypothesis of the study was that dental caries experience in the children of Dili was significantly greater in 2014 compared to 2002.

4.3 Methods

The 2014 oral health survey of Dili's children replicated the methods described by Roberts-Thomson and colleagues in the AusAID report (AusAID 2002). Ethical approval for the research was granted by the University of Tasmania Human Research Ethics Committee (reference H13216).

4.3.1 Study Design

Two cross-sectional epidemiological surveys of the oral health of Dili's children.

4.3.2 Study Population

Children aged 6-17 years enrolled in primary, junior and senior high schools in the district of Dili in 2002 and 2014.

4.3.3 Sampling Strategy

The methods of the 2002 East Timor National Oral Health Survey and the Oral Health Knowledge, Attitudes and Behaviour Survey have been previously reported (AusAID 2002).

The sampling strategy of the 2014 survey was informed by the 2002 survey. The Dili component of the 2002 survey randomly selected two of the six sub-districts of Dili, while the 2014 survey randomly selected four sub-districts. The two additional sub-districts were selected to account for the increased population size of Dili in 2014 compared to 2002. For the 2014 survey, the sub-districts of Dom Aleixo, Cristo Rei, Metinaro and Vera Cruz were randomly selected for inclusion. Forty schools were selected for inclusion in the study. The number of schools selected for each sub-district was proportional the the size of the population within the sub-district. For each local area we attempted to recruit one primary school, one junior high school and senior high school. However, for the 2014 survey, not all localities had all three school types. All schools invited to participate agreed to take part in the study.

4.3.4 Sample Size and Study Power

Data from the 2010 Timor-Leste census shows there were 61,300 children aged 6-17 years residing in the Dili region. This study recruited 758 children, or 1.2% of children in these age groups living in Dili.

The 2002 survey recruited 1,024 children across Timor-Leste and 201 children in Dili. The sample size required for the 2014 survey was calculated based on a hypothesised 25% greater (from 2002 level) prevalence of dental caries in the permanent dentition. The 2002 survey found 48% of children living in Dili had one or more teeth with decay. In order to achieve >80% power to detect a significant difference in the prevalence of decay at alpha level 0.05, we calculated that three times as many children (n = 603) would need to be recruited for the 2014 oral examination. As the 2002 survey recruited 77.5% of the target number of child participants (AusAID, 2002) we calculated that 800

children would need to be invited to participate to recruit approximately 620 participants.

4.3.5 Recruitment

Recruitment took place within 40 schools, with students randomly selected and invited to participate. Equal numbers of children were invited to participate from each of the four age strata (6–8, 9–11, 12–14 and 15–17 years).

Children were provided with a study information sheet and consent form to take home for their parent or guardian to read and complete. One week later the study team visited the school to complete surveys and oral examinations. All parents/guardians provided written consent for their child to participate. All children were accompanied by their parent/guardian for the survey and oral examination.

4.3.6 Participants

Participants were children aged 6 to 17 years who were attending participating schools.

4.3.7 Data Collection

A questionnaire was used to collect data on demographics and oral health behaviours. The 2014 survey used the same questions as the 2002 survey. The questionnaire was designed in English then translated into Tetum (Timor-Leste's official language). The questionnaire obtained information on tooth brushing, use of toothpaste, time since last dental visit, reason for visit, the type of professional visited and treatment received. Parents and guardians completed the questionnaire at home or at the child's school. For those who were illiterate, the questionnaire was orally administered by a member of the research team during the school data collection visit.

Oral epidemiological examinations were conducted by dental health professionals (four dentists and five dental nurses) who had completed a five-day training, standardisation and calibration workshop. All parents/guardians were invited to accompany their child throughout the oral examination. Children were seated in a proclined position and natural sunlight was used. The examination collected information on the number of teeth present, caries prevalence and severity, oral hygiene and the gingival condition. Children's dental status was scored using the decayed missing and filled teeth index

(dmft) for deciduous teeth and permanent teeth (DMFT). In addition, periodontal status was assessed using calculus and bleeding indices (WHO 1997).

4.3.8 Data Analysis

Data from the surveys and oral examinations was entered into a spreadsheet by the lead researcher (LFBS). This was amalgamated with data on children living in Dili from the 2002 survey and oral examination, kindly provided by Roberts-Thomson and colleagues. The data were checked for accuracy and completeness prior to export to IBM SPSS version 23 for data analysis. With the exception of the preliminary investigation of age and sex distributions across the surveys, the data were weighted to the age and gender distribution of children in Dili based on the 2010 census (GOTL 2010). Data on toothache, avoiding eating and unhappy about appearance of teeth was collected on a Likert scale with the categories: never, hardly ever, sometimes, often and very often. This data was dichotomised for analysis, to never/hardly ever and sometimes/often/very often. Chi-square tests were utilised to investigate the proportion of children in 2014 vs. 2002 who reported specific oral health behaviours (e.g. tooth brushing the previous day), visits to dentists and receipt of treatment and oral health status (e.g. the presence of gingival bleeding). Independent t-tests were used to investigate mean numbers of decayed, missing or filled deciduous and permanent teeth. All tests were two-sided and differences were accepted as significant at alpha 0.05 level.

4.4 Results

The 2002 survey recruited 1042 children aged 6 to 17 years in Timor-Leste, with 201 of these residing in Dili. The 841 children who participated in the 2002 survey, but resided in other regions of Timor-Leste were excluded. The 2014 survey in Dili recruited 758 participants (95% response rate) aged 6 to 17 years, or 1.2% of the 61,300 children within this age group living in Dili according to the 2010 census (GOTL 2010). Overall, and in all age groups, there was no significant difference in the proportion of males to females (Table 4.1). A smaller number of children (n = 655, 82% response rate) were recruited to the oral examination component. This was due to some children being absent from school on the day of the oral examination and some children being unwilling to participate in this component of the research.

Table 4.1. Sex distribution by age 2002 and 2014 Dili child oral health surveys (unweighted data)

	2002 Oral health survey Dili Data (n = 201)				2014 Oral health survey Dili (n = 758)				*p*-value
Sex	**Male**		**Female**		**Male**		**Female**		
Age	n	%	n	%	n	%	n	%	
6–8 years old	31	57.4	23	42.6	90	48.4	96	51.6	0.24
9–11 years old	33	58.9	23	41.1	105	53.3	92	46.7	0.46
12–14 years old	28	53.8	24	46.2	97	53.9	83	46.1	1.00
15–17 years old	14	41.2	20	58.8	96	49.2	99	50.8	0.39
Total	106	54.1	90	45.9	388	51.2	370	48.8	0.47

***Note**: Missing data n = 5 for NOHS 2002*

A slightly lower proportion of children reported brushing their teeth the previous day, a larger proportion of children reported suffering from toothache (sometimes to very often) during the last 12 months or avoiding eating due to toothache, and the proportion of children who reported being unhappy about the appearance of their teeth was higher in 2014 compared to 2002 (Table 4.2). There was no difference in the proportion of children who had ever visited a dentist between the two surveys. However, a larger proportion of children reported having visited a dentist during past 12 months in 2014 compared to 2002.

Table 4.2. Oral hygiene, self-reported oral health and dental visiting behaviour Dili 2002 vs 2014 (data weighted to Dili 2010 Census population)

Variable	NOHS 2002 Dili (n = 201) % (95% CI)	NOHS 2014 Dili (n = 758) % (95% CI)	*p*-value
Oral Hygiene			
Toothbrushing yesterday	100.0 (98.2, -)	96.7 (95.2, 97.9)	0.01
Use of toothpicks	69.9 (62.5, 76.7)	62.4 (58.8, 65.9)	0.06
Use of toothpaste	99.5 (97.2, 100.0)	99.5 (98.6, 99.9)	0.95
Self-Reported Oral Health			
Toothache during last 12 months*	19.2 (14.0, 25.4)	40.2 (36.5, 44.0)	< 0.001
Avoid eating during last 12 months due to toothache or pain*	12.5 (8.1, 18.2)	34.6 (31.0, 38.3)	< 0.001
Unhappy about appearance of teeth*	10.6 (6.4, 16.2)	36.3 (32.7, 40.0)	< 0.001
Dental Visiting Behaviour			
Ever visited a dentist	47.5 (39.5, 55.6)	44.5 (40.9, 48.1)	0.50
Visited a dentist during past 12 months	7.0 (3.5, 12.1)	23.9 (20.9, 27.1)	< 0.001
Last visited a dentist due to a problem (pain, decay, bleeding gum or trauma) among all children who visited a dentist during the past 12 months	93.2 (84.7, 97.7)	89.2 (85.1, 92.5)	0.32

** Sometimes to very often during past 12 months*

The prevalence of, and extent of sites with, gingival bleeding and calculus was higher in 2002 compared to 2014 (Table 4.3).

Table 4.3. Prevalence and extent of sites with gingival bleeding and calculus Dili 2002 vs 2014 (data weighted to Dili 2010 Census population)

	NOHS 2002 Dili (n = 201) % or Mean (95% CI)	NOHS 2014 Dili (n = 655) % or Mean (95% CI)	Dili 2002 vs Dili 2014 *p*-value
Prevalence of gingival bleeding (%)	81.0 (74.9, 86.1)	64.6 (60.8, 68.2)	< 0.001
Extent of sites with gingival bleeding (%)	81.0 (74.9, 86.1)	64.6 (60.8, 68.2)	< 0.001
Prevalence of calculus (%)	85.8 (80.2, 90.3)	57.1 (53.2, 60.9)	< 0.001
Extent of sites with calculus (mean %)	57.7 (57.4, 58.0)	25.4 (25.3, 25.5)	< 0.001

There was no difference in the prevalence of decay in the primary dentition, the mean number of decayed (d) teeth or total decayed, missing or filled (dmft) teeth in the primary dentition in 2014 compared to 2002 (Table 4.4). However, the mean number of filled (f) teeth in the primary dentition was significantly higher in 2014 compared to 2002 ($t_{(654)} = -3.28$, $p = 0.001$).

The proportion of children with decayed permanent teeth (D) was significantly greater in 2014 compared to 2002 (χ^2 (1) = 17.74, $p < 0.0001$) (Table 4.4). The mean number of filled permanent teeth (F) was significantly higher in 2014 compared to 2002 ($t_{(853)} = -2.89$, $p = 0.004$) and mean DMFT (permanent teeth) was also significantly greater in 2014 compared to 2002 ($t_{(399)} = -2.83$, $p = 0.01$).

Table 4.4. Prevalence and mean number decayed teeth, missing teeth, filled teeth in the primary and permanent dentitions Dili 2002 vs 2014 (data weighted to Dili 2010 Census population)

	NOHS 2002 Dili (n = 201) mean or % (95% CI)	NOHS 2014 Dili (n = 655) mean or % (95% CI)	Dili 2002 vs Dili 2014 *p*-value
Primary dentition			
Prevalence Of Decay	36.8 (30.1, 43.8)	38.8 (35.0, 42.6)	0.61
Prevalence of missing teeth	6.4 (3.4, 10.7)	8.1 (6.1, 10.5)	0.42
Prevalence of filled teeth	0.0	1.8 (1.0, 3.2)	0.08

	NOHS 2002 Dili (n = 201) mean or % (95% CI)	NOHS 2014 Dili (n = 655) mean or % (95% CI)	Dili 2002 vs Dili 2014 *p*-value
Mean number of decayed teeth (d)	1.71 (1.68, 1.74)	1.81 (1.80, 1.82)	0.69
Mean number of missing teeth (m)	0.09 (0.04, 0.14)	0.15 (0.10, 0.20)	0.07
Mean number of filled teeth (f)	0.0 (-)	0.02 (0.01, 0.03)	0.001
Mean dmft	1.80 (1.77, 1.83)	1.99 (1.74, 2.24)	0.47
Permanent Dentition			
Prevalence of decay	53.4 (46.3, 60.4)	69.8 (66.1, 73.3)	< 0.001
Prevalence of missing teeth	9.9 (6.1, 14.8)	8.2 (2.0, 4.9)	0.48
Prevalence of filled teeth	1.5 (0.3, 4.2)	3.2 (2.0, 4.9)	0.19
Mean number of decayed teeth (D)	1.6 (1.58, 1.62)	2.1 (1.89, 2.23)	0.01
Mean number of missing teeth (M)	0.11 (0.06, 0.16)	0.14 (0.10, 0.18)	0.56
Mean number of filled teeth (F)	0.01 (-0.01, 0.03)	0.07 (0.04, 0.10)	0.004
Mean DMFT	1.73 (1.71	2.26 (2.07, 2.45)	0.006
Primary And Permanent Dentition			
Prevalence of decay d+D	81.9 (75.9, 86.9)	87.5 (84.7, 90.0)	0.04
Mean dmft+DMFT	3.53 (3.50, 3.55)	4.24 (3.96, 4.52)	0.01

The prevalence of decay in the both the deciduous and permanent dentitions (did) was higher in 2014 than 2002 (χ^2 (1) = 4.11, p = 0.04). Children living in Dili in 2014 had a greater mean number of dmft+DMFT than in 2002 ($t_{(399)}$ = -2.59, p = 0.01).

4.5 Discussion

Dental caries experience in Dili school children was significantly greater in 2014 compared to 2002, due to more tooth decay in permanent teeth. The percentage of children with decay in their permanent teeth was 30.7% higher in 2014 compared to 2002 and mean dmft/DMFT was 20% greater. This supports the hypothesis that dental caries experience in the children of Dili increased over the 12 year time span between the two surveys. There was also a higher mean number of filled deciduous and permanent teeth in 2014 compared to 2002.

The greater dental caries experience in 2014 may be related to increased sugar consumption and with the change to a more youthful population, dental caries experience in Timor-Leste can be expected to continue to increase in the future (Beaglehole et al 2009; Petersen 2005; UN 2014; Whittington 2014). Almost all sugar consumed in Timor-Leste is imported and there was a large increase in the sugar imports to Timor-Leste between 2003 and 2011. In 2003, sugar imports were 756 tonnes, or 5.2 kg/person/year while in 2007 it was 933 tonnes or 8.5 kg/person/year (FAO 2015; Knoema 2015). By 2014 sugar imports had reached 1883 tonnes (FAO 2015; Knoema 2015). This represents a 149% increase in sugar imports between 2003 and 2014. The higher dmft/DMFT in 2014 may also reflect the movement of people into Dili from the rural areas since the Indonesian troops left. This movement may have resulted in more people moving from traditional Timor diets to Western-style diets as occurred in India (Bowen et al 2011). The increased dental caries experience may also be related to the slightly lower proportion of children who reported brushing their teeth yesterday in 2014 compared to 2002. However, the decreased prevalence and extent of gingival bleeding and calculus suggested oral hygiene may have been better in 2014 than in 2002. The increased dental caries experience may help explain why the incidence of toothache in the previous 12 months, avoiding eating due to toothache, and being unhappy about the appearance of their teeth was higher in 2014 to 2002.

The larger mean number of filled teeth in 2014 suggested that the dental service was able to supply more restorative dental care in 2014 than 2002. The fact that a higher proportion of children had reported seeing a dentist in the previous 12 months in 2014 than in 2002 indicated that the dental service had been able to increase its restorative service delivery over the year prior to 2014. However, the greater prevalence of decay and larger mean number of permanent decayed teeth indicated that the dental service was unable to supply the volume of dental restorative care required. The findings of our research emphasise the need to increase the delivery of oral health promotion efforts, and improve access to routine and restorative dental care, for children in Timor-Leste.

The greater dental caries exposure, combined with the changing demographic to a younger population in Timor-Leste, will have large implications for the oral health sector. Rapid changes to Western diets have been found in other developing economies such as South Africa and Benin (Delisle 2008; UN-RSCN 2006). The change from a

low sugar diet to a Western high sugar diet has had an impact on overall health and oral health in other nations (WHO 1997; Bowen et al 2011; Al-Malik et al 2002). A growing youth population has been shown to be related to increased dental caries prevalence (Knoema 2015; Yee and McDonald 2003).

There were several limitations with this study. The baseline of individual sugar consumption in the children of Dili was not established in the 2002, study making it impossible to assess change in sugar consumption among children in Dili in 2014. Change in sugar consumption was limited to the change in sugar imports for all of Timor-Leste. The survey did not include the local dialects of Timor-Leste and may have missed some demographic groupings, thereby reducing the demographic diversity in the survey participants. Strengths of the study include that it used a randomised sample age and sex break down analogous to the 2002 survey study. The study also recruited a sufficiently large number of children to provide sufficient power to test the study hypothesis. The study provided an important contribution to the oral health profile of the change in oral health status and limitations.

Further research needs to be undertaken to identify children most vulnerable to dental caries within Dili and Timor-Leste, e.g. low socioeconomic groups, and to develop oral health policies suitable for the Timor-Leste situation, such as oral health promotion targeted at particular demographic groups, salt fluoridation, supplying affordable toothbrushes and toothpaste, school-based dental health education and screening, and fluoride and fissure sealant programs.

4.6 Conclusion

There was greater dental caries experience in Dili school children in 2014 than 2002, associated with a greater permanent teeth dental caries experience.

4.7 Postscript

In this chapter it has been shown that the teeth decayed experience (dmft+DMFT) in children in the District of Dili has significantly increased between the two surveys, as a result of more dental caries in permanent dentition. This result validates the hypothesis of the 2014 study that dental caries in Dili children has increased since the 2002 Timor-Leste National Oral Health Survey.

In the next chapter (**Chapter 5**), an investigation of the association between school socio-economic status (SES) and dental caries experience (dmft+DMFT) in children living in Dili, Timor-Leste is presented. In the chapter thereafter (**Chapter 6**), an investigation of the association between parental education level and the prevalence of carious primary and permanent teeth (d+D) in children of Dili, Timor-Leste is presented.

Chapter 5

The Association of School Socio-Economic Status and Dental Caries Experience in Children in Dili, Timor-Leste.

5.1 Preface

In the previous chapter, a comparison of dental caries severity (mean dmft+DMFT) from data collected in the 2002 and 2014 surveys, found higher dmft+DMFT in 2014. This was due to greater dental caries experience in the permanent dentition in 2014 compared to 2002. The result supported the hypothesis that dental caries in children living in Dili increased over the 12 year time span between the two surveys.

In this chapter, the association between school socio-economic status (SES) and dental caries experience (dmft, DMFT and dmft+DMFT) is investigated among children who participated in the 2014 survey. A condensed version of the text that follows is presented in a paper titled 'The association of socio-economic status and dental caries experience in children in Dili, Timor-Leste', which has been published in the *Asia Pacific Journal of Public Health.* 2016. 28(7):620-628 (Appendix 15).

5.2 Introduction

Oral health is integral and essential to general health and wellbeing, and impacts on quality of life. There is a strong correlation between several oral diseases and non-communicable chronic diseases as a primary result of common risk factors, such as smoking, unhealthy diet habits, and poor hygiene practices (WHO 2006).

The Democratic Republic of Timor-Leste (East Timor) is one of the poorest countries in the world (Saikia 2011). It is a tiny half-island country located in the eastern part of Timor Island in Southeast Asia. In 1999 East Timor held a referendum, with 78% of the population voting for independence from Indonesia. The response from the militia backed by the Indonesian military was devastating, 80% of schools and health clinics were destroyed, and one third of the population was displaced (UNDP 2002). Multinational peacekeepers were sent to restore order and establish basic public

services (MoH & NSO-TL 2003) on May 20, 2002 Timor-Leste was officially declared an independent country. It is estimated that there will be a threefold increase in the population between 2005 and 2050 (UN-WPP 2002). As Asia's newest and fastest growing nation, Timor-Leste faces significant demographic challenges (Saikia 2011).

Little is known about the dental history of Timor-Leste prior to 2002. In 2002, a National Oral Health Survey was undertaken in Timor-Leste (AusAID 2002). This found a high level of primary teeth caries experience and a moderate level of permanent teeth caries experience, both mostly presenting as untreated decayed teeth. A follow-up survey (Babo Soares et al 2016) found that dental caries experience (dmft+DMFT) was significantly greater in Dili children in 2014 than 2002, with this considered to be related to the large increase in sugar imports and consumption during the intervening period.

There has been a reduction in dental caries experience in developed economies in the last decade, but an increase in developing economies (MoH & NSO-TL 2003). A systematic review and meta-analysis demonstrated that in all the studies assessed (83 in developed countries, 66 in developing and underdeveloped countries), exposure to dental caries was significantly greater in people of low socio-economic status (SES) than in people of high SES (Schwendicke et al 2015).

As providing oral health services is a challenge in developing countries (Petersen et al 2005) such as Timor-Leste, it is vital that policy makers and dental clinicians know whether the relationship between SES status and dental caries experience as found in other countries holds in Timor-Leste, so that appropriate policies can be created and implemented. The aim of this paper is to investigate the association between SES and dental caries experience in children living in Dili, Timor-Leste.

5.3 Methods

The 2014 oral health survey of Dili's children replicated the methods described by Roberts-Thomson and colleagues for their 2002 National Oral Health Survey (AusAID 2002). Ethical approval for the research was granted by the University of Tasmania Human Research Ethics Committee (reference H13216).

5.3.1 Study Design

Cross-sectional epidemiological survey of the oral health of Dili's children.

5.3.2 Study Population

Children aged 6-17 years attending primary, junior and senior high schools in Dili in 2014.

5.3.3 Sampling Strategy

Four of Dili's six sub-districts were randomly selected: Dom Aleixo, Cristo Rei, Metinaro and Vera Cruz. Within these four sub-districts, 40 schools were randomly selected to participate. The number of schools selected was proportional to the population of the sub-district. Accordingly, 18 schools were selected in Dom Aleixo, 13 in Cristo Rei, 7 in Vera Cruz and 3 in Metinaro. We sought to invite approximately equal numbers of primary, junior high school and senior high schools, although some local areas did not have all three school types.

5.3.4 Recruitment

Recruitment took place within 40 schools, with students randomly selected and invited to participate. Equal numbers of children were invited to participate from each of the four age strata (6–8, 9–11, 12–14 and 15–17 years). Children were provided with a study information sheet and consent form to take home for their parent or legal guardian to read and complete. One week later, the study team visited the school to undertake the surveys and oral examinations. All parents/guardians provided written consent for their child to participate.

5.3.5 Participants

Participants were randomly selected from children attending the participating schools.

5.3.6 Data Collection

A questionnaire was used to collect data on demographics and oral health behaviours. The questionnaire was designed in English then translated into Tetum (Timor-Leste's official language). The questionnaire obtained information on tooth brushing, use of toothpaste, time since last dental visit, reason for that visit, the type of professional visited and treatment

received. For those parents/guardians who were illiterate, a member of the research team orally administered the questionnaire during the school data collection visit.

Oral epidemiological examinations were conducted by dental health professionals (four dentists and five dental nurses) who had completed a five-day training, standardisation and calibration workshop. Inter-rater reliability was assessed after the training workshop by comparing the examination findings of dental health professionals against a gold standard examiner for a sample of 69 children. These analyses found a mean Krippendorff alpha of 0.93, indicating a high level of agreement between the trainees and the gold standard examiner. Oral examinations were conducted in school classrooms, children were seated in a proclined position and examined under natural sunlight. All parents/guardians were invited to accompany their child throughout the oral examination. The examination collected information on the number of teeth present, caries prevalence and severity, gingival condition and the presence of calculus. Children's dental caries experience was scored using the decayed missing and filled teeth index for both deciduous teeth (dmft) and permanent teeth (DMFT). The combined measure of dmft+DMFT was reported as the participants usually had a mixed (deciduous and permanent) dentition making the combined dmft+DMFT more relevant than separate dmft and DMFT measures. Periodontal status was assessed using calculus and bleeding indices (Hosseinpoor et al 2012).

5.3.7 Socio-Economic Status

SES categorisation was based on whether the schools were private or government owned on the facilities and condition of the school. Other than a single Muslim community school, private schools were owned by catholic and protestant churches/organizations and could only be afforded by wealthier people, hence these schools were classified as mid to high SES. The government-owned schools and the Muslim community school SES classification was based on the level of sanitation, whether clean water was available and the relative cleanliness of the environment within the school facilities.

5.3.8 Data Analysis

Data from the surveys and oral examinations was entered into a spreadsheet by the lead researcher (LFBS). The data were checked for accuracy and completeness prior to export to IBM SPSS version 23 for data analysis. With the exception of the preliminary

investigation of age and sex distributions across the surveys, the data were weighted to the age and gender distribution of children in Dili, based on the 2010 census (GOLT 2010). For the bivariate and multivariate analyses, only children who participated in both components (questionnaire and oral examination) were included.

Chi-square tests were utilised to investigate the proportion of children between groups who reported specific oral health behaviours (e.g. tooth brushing the previous day), visits to dentists and receipt of treatmen and oral health status (e.g. the presence of gingival bleeding). Independent t-tests were used to investigate mean numbers of decayed, missing or filled deciduous (dmft), permanent (DMFT) teeth and both deciduous and permanent teeth (dmft+DMFT teeth) between the two groups. One-way analysis of variance (ANOVA) was used to investigate mean dmft+DMFT by age group. Levene's statistic was used to test homogeneity of variance and Welch's robust test was used to test equality of means, with a post-hoc Games-Howell test used to determine significant differences between age groups for dmft, DMFT and dmft+DMFT.

Variables that were significantly associated with both dmft and SES in bivariate analyses were entered into a backward elimination multivariable linear regression model with dmft as the dependent variable and age group as a covariate (with age 6-8 years the reference category). The regression model was validated through checking the distribution of the residuals, and investigating collinearity diagnostics and Cook's distance measures. All tests were two-sided and differences were accepted as significant at alpha 0.05 level.

The original sample size calculation was conducted for the cross-sectional comparative study of the prevalence of decay at two different points in time (Babo Soares et al 2016). As the aims of this sub-study are different to the original study, a post-hoc power calculation was conducted for the results reported in this paper. This found that the study had >80% power at alpha level 0.05 to detect a significant difference in mean dmft+DMFT between the low SES group and mid to high SES group.

5.4 Results

5.4.1 Descriptive Results

In total, 800 children were invited to participate, 758 took part in the oral health behaviours questionnaire (95% response rate) and 655 participated in the oral examination (82% response rate). A smaller number of children (n = 655) were recruited to the oral examination component because some children were absent from school on the day of the oral examination and some declined to participate in this component of the research.

Data from the 2010 Timor-Leste census shows there were 61,300 children aged 6-17 years residing in the Dili region. This study recruited 758 children, or 1.2% of children in these age groups living in Dili.

All of the schools in Metinaro subdistrict were classified as low SES (105 participants). All of the schools in Cristo Rei (141 participants), Dom Aleixo (292 participants) and Vera Cruz (117 participants) as mid to high SES (Table 5.1).

Table 5.1. Socio-economic status (demined according to study criteria) of participating schools

Dili Sub-district	n	Socio-Economic Status	Location
Cristo Rei	141	Mid-High	Part urban & part rural
Dom Aleixo	292	Mid-High	Urban
Metinaro	105	Low	Rural
Vera Cruz	117	Mid-High	Urban

Almost all the parents/guardians (96.7%) reported that their children had brushed their teeth the previous day, and 36.8% of the children suffered from toothache (sometimes to very often) during the previous 12 months and 33.3% reported being unhappy about the appearance of their teeth. Under a quarter (23.8%) of the children had visited a dentist in the previous 12 months and 44.6% had visited a dentist at least once during their life.

Most of the children exhibited gingival bleeding (64.6%) and calculus (57.1%). Primary dentition dental caries was present in over a third of the children (38.8%). The mean

number of primary teeth decayed (d) teeth was 1.8. The mean number of missing (m) and filled (f) teeth in the primary dentition was 0.2 and 0.02 respectively. The mean number of decayed, missing or filled primary teeth was 1.9.

Permanent dentition dental caries was present in over two-thirds of children (69.5%). The mean number of decayed (D) permanent teeth was 2.1, with a mean of 0.1 missing (M) teeth and and 0.1 filled (F) teeth. The mean number of decayed, missing or filled permanent teeth was 2.5. The mean dmft+DMFT was 4.2.

5.4.2 Bivariate Analysis

There were 655 children included in the bivariate analysis. dmft was greater in children from mid to high (mean 2.2) compared to low SES schools (mean 1.1) ($t_{(203)} = -3.0$, $p < 0.0001$). There was no difference in mean DMFT or mean dmft+DMFT between the low SES and mid-high SES school groups (Table 5.2).

Table 5.2. Bivariate analysis of school socio-economic status with dmft, DMFT and dmft+DMFT (data weighted to Dili 2010 Census population)

Variable	Low (n = 105) Mean (95% CI)	Mid to High (n = 550) Mean (95% CI)	*p*-value
dmft	1.12 (0.68, 1.56)	2.15 (1.86, 2.44)	< 0.001
DMFT	2.61 (2.07, 3.15)	2.19 (1.98, 2.40)	0.12
Dmft+DMFT	3.72 (3.04, 4.40)	4.34 (4.04, 4.64)	0.11

There was no difference in the age distribution of children in the low SES and mid-high SES groups (Table 5.3). A greater proportion of children in the mid-high SES groups had a mother or father with at least high school or higher education level. The use of toothpicks was greater in children who attended mid-high compared to low SES schools level.

Children in low SES schools were more likely to be unhappy about the appearance of their teeth, suffer from toothache sometimes to very often, avoid eating due to toothpain sometimes to very often, have visited a dentist in the past 12 months, visited a dentist

due to a problem (pain, decay, bleeding or trauma) pain, and have calculus present than children attending mid to high SES schools.

Table 5.3. Bivariate analysis of socio-economic status with putative confounders (data weighted to Dili 2010 Census population)

Variable	Low (n = 105) % (95% CI)	Mid to High (n = 550) % (95% CI)	*p*-value
Age group			
6-8 years	27.6 (19.3, 37.2)	28.1 (24.3, 32.0)	
9-11 years	28.6 (20.2, 38.2)	23.9 (20.3, 27.7)	
12-14 years	20.0 (12.8, 28.9)	21.7 (18.3, 25.4)	0.77
15-17 years	23.8 (16.0, 33.1)	26.4 (22.8, 30.3)	
Sub-total	*100.0*	*100.0*	
Education level - senior high school or above (father or mother)	24.8 (16.9, 34.1)	80.2 (76.6, 83.4)	< 0.001
Use of toothpicks	48.6 (38.7, 58.5)	63.3 (59.1, 67.3)	0.01
Unhappy about appearance of teeth*	45.1 (35.2, 55.3)	33.7 (29.6, 38.1)	0.03
Toothache*	49.5 (39.5, 59.5)	38.1 (33.8, 42.5)	0.03
Avoid eating due to tooth pain*	46.4 (36.2, 56.8)	32.0 (27.8, 36.3)	0.006
Ever visted a dentist	50.5 (40.5, 60.4)	44.2 (40.0, 48.4)	0.24
Visted a dentist during past 12 months	36.8 (27.6, 46.7)	22.8 (19.3, 26.5)	0.02
Visted a dentist due to a problem last visit†	97.8 (88.5, 99.9)	87.5 (82.3, 91.6)	0.04
Extraction at last dentist visit	26.1 (14.3, 41.1)	37.7 (31.2, 44.5)	0.14
Gingival bleeding	57.1 (47.1, 66.8)	66.0 (61.9, 70.0)	0.08
Calculus	66.7 (56.8, 75.6)	55.3 (51.0, 59.5)	0.03

**Sometimes to very often during the past 12 months.*

***Note**: Weighting of data results in slight changes in the number of participants in each age group and by sex. To avoid confusion, percentages only are reported. †Problem defined as pain, decay, bleeding or trauma.*

Mean dmft was higher in children aged 6-8 years compared to 9-11 years (Table 5.4). Exfoliated deciduous teeth were not counted as missing teeth. Mean dmft was also higher among children who did not use toothpicks compared to children who used toothpicks, among children who had toothache sometimes to very often, those who

reported avoided eating due to tooth pain sometimes to very often and children who had visited a dentist during the past 12 months than those who had not visited a dentist during the past 12 months.

Table 5.4. Bivariate analysis of dmft and putative confounders (data weighted to Dili 2010 Census population)

Variable	dmft Mean (95% CI)	*p*-value
Age group		
6-8 years	5.08 (4.76, 5.40)	< 0.001
9-11 years	2.17 (1.78, 2.56)	
12-14 years	-	-
15-17 years	-	-
Parental Education		
None or lower than high school	1.91 (1.46, 2.36)	0.71
High school or above	2.02 (1.72, 2.32)	
Toothpicks		
Does not use toothpicks	2.60 (2.16, 3.04)	< 0.001
Uses toothpicks	1.59 (1.29, 1.89)	
Unhappy With Appearance Of Teeth		
Never or hardly ever	1.87 (1.54, 2.20)	0.54
Sometimes to very often	2.05 (1.60, 2.50)	
Toothache		
Never or hardly ever	1.67 (1.36, 1.98)	0.02
Sometimes to very often	2.30 (1.84, 2.76)	
Avoid Eating Due To Tooth Pain		
Never or hardly ever	1.95 (1.61, 2.29)	0.58
Sometimes to very often	1.79 (1.36, 2.22)	
Ever Visited A Dentist		
No	1.85 (1.54, 2.16)	0.24

Variable	dmft Mean (95% CI)	*p*-value
Yes	2.15 (1.74, 2.56)	
Visted A Dentist During Past 12 Months		
Not during past 12 months	1.75 (1.48, 2.020	0.005
During past 12 months	2.70 (2.10, 3.30)	
Reason For Dental Visit		
Check-up	2.07 (0.56, 3.58)	0.82
Problem (pain, decay, bleeding or trauma)	2.23 (1.78, 2.69)	
Treatment		
Check-up or other treatment	2.48 (1.90, 3.06)	0.12
Extraction	1.75 (1.10, 2.40)	
Gingival Bleeding		
No	1.70 (1.29, 2.11)	0.10
One or more sites	2.14 (1.82, 2.46)	
Calculus		
No	2.20 (1.79, 2.61)	0.15
At one or more sites	1.82 (1.51, 2.13)	

Mean DMFT was higher among children who were unhappy with the appearance of their teeth, among children who had toothache sometimes to very often and those who avoided eating due to tooth pain sometimes to very often (Table 5.5). The use of toothpicks was borderline significiant, with a slightly higher mean DMFT among children who used toothpicks. Mean DMFT was also higher among children who had never visited a dentist. Among those children who had previously visited a dentist, mean DMFT was higher among children who had visited a dentist within the past 12 months compared to children who not visited the dentist within the past 12 months. Mean DMFT was also higher in children who last visited a dentist due to a problem, among children who had an extraction at last dental visit and among children with calculus.

Table 5.5. Bivariate analysis of DMFT and putative confounders (data weighted to Dili 2010 Census population)

Variable	DMFT Mean (95 % CI)	*p*-value
Age group		
6-8 years	-	
9-11 years	-	
12-14 years	2.85 (2.42, 3.38)	0.10
15-17 years	3.39 (2.93, 3.85)	
Parental Education		
None or lower than high school	2.50 (2.12, 2.88)	0.11
High school or above	2.16 (1.94, 2.38)	
Toothpicks		
Does not use toothpicks	2.01 (1.72, 2.30)	0.046
Uses toothpicks	2.42 (2.16, 2.68)	
Unhappy With Appearance Of Teeth		
Never or hardly ever	2.02 (1.79, 2.25)	< 0.001
Sometimes to very often	2.86 (2.46, 3.26)	
Toothache		
Never or hardly ever	1.98 (1.75, 2.21)	< 0.001
Sometimes to very often	2.77 (2.40, 3.14)	
Avoid Eating Due To Tooth Pain		
Never or hardly ever	2.01 (1.78, 2.24)	< 0.001
Sometimes to very often	2.97 (2.57, 3.37)	
Ever visited a dentist		
No	2.62 (2.29, 2.95)	0.001
Yes	1.96 (1.74, 2.18)	
Visted A Dentist During Past 12 Months		
Not during past 12 months	2.09 (1.89, 2.29)	0.01
During past 12 months	2.76 (2.28, 3.24)	

Variable	DMFT Mean (95 % CI)	*p*-value
Reason For Dental Visit		
Check-up	1.16 (0.56, 1.76)	< 0.001
Problem (pain, decay, bleeding or trauma)	2.84 (2.46, 3.22)	
Treatment		
Check-up or other treatment	2.26 (1.88, 2.64)	0.01
Extraction	3.39 (2.70, 4.08)	
Gingival Bleeding		
No	2.15 (1.81, 2.49)	0.41
One or more sites	2.32 (2.09, 2.55)	
Calculus		
No	2.03 (1.73, 2.33)	0.048
At one or more sites	2.43 (2.18, 2.68)	

The highest mean dmft+DMFT was found among children aged 6-8 years ($F_{(3, 356)}$ = 21.7, $p < 0.001$) (**Error! Reference source not found.**). A post-hoc Games Howell test found there was a significant difference in mean dmft+DMFT between children aged 6-8 years and all other age groups (all $p < 0.001$). Children aged 9-11 had a significantly different mean dmft+DMFT compared to children aged 12-14 years ($p < 0.001$) and 12-14 years ($p = 0.047$). There was no significant difference in mean dmft+DMFT between the 12-14 yeas and 15-17 years age groups ($p = 0.53$).

Children who used toothpicks, were unhappy with the appearance of their teeth, had toothache sometimes or very often during the past 12 months, had ever visited a dentist, had visited a dentist in the last 12 months had a higher mean dmft+DMFT than children who did not report these issues. Additionally, children who last visited a dentist due to a problem and those with gingival bleeding had higher mean dmft+DMFT.

Table 5.6. Bivariate analysis of dmft+DMFT and putative confounders (data weighted to Dili 2010 Census population)

Variable	dmft+DMFT Mean (95% CI)	*p*-value
Age group		
6-8 years	5.94 (5.31, 6.57)	< 0.001
9-11 years	4.31 (3.80, 4.81)	
12-14 years	2.97 (2.54 3.40)	
15-17 years	3.41 (2.94, 3.87)	
Parental Education		
None or lower than high school	4.41 (3.90, 4.92)	0.45
High school or above	4.18 (3.85, 4.51)	
Toothpicks		
Does not use toothpicks	4.61 (4.14, 5.08)	0.04
Uses toothpicks	4.01 (3.67, 4.35)	
Unhappy With Appearance Of Teeth		
Never or hardly ever	3.89 (3.54, 4.24)	0.001
Sometimes to very often	4.91 (4.42, 5.40)	
Toothache		
Never or hardly ever	3.65 (3.31, 3.99)	< 0.001
Sometimes to very often	5.07 (4.58, 5.56)	
Avoid Eating Due To Tooth Pain		
Never or hardly ever	3.95 (3.59, 4.31)	0.01
Sometimes to very often	4.76 (4.26, 5.26)	
Ever visited a dentist		
No	3.81 (3.47, 4.15)	0.001
Yes	4.77 (4.33, 5.21)	
Visted A Dentist During Past 12 Months		
Not during past 12 months	3.84 (3.54, 4.14)	< 0.001

Variable	dmft+DMFT Mean (95% CI)	*p*-value
During past 12 months	5.46 (4.84, 6.08)	
Reason for dental visit		
Check-up	3.24 (1.87, 4.61)	0.02
Problem (pain, decay, bleeding or trauma)	5.07 (4.58, 5.56)	
Treatment		
Check-up or other treatment	4.73 (4.15, 5.31)	0.4
Extraction	5.14 (4.35, 5.93)	
Gingival bleeding		
No	3.85 (3.40, 4.30)	0.04
One or more sites	4.5 (4.11, 4.81)	
Calculus		
No	4.24 (3.80, 4.68)	0.97
At one or more sites	4.25 (3.89, 4.61)	

5.4.3 Multivariable Analysis

As DMFT, and dmft+DMFT, were not significantly associated with school SES, multivariable analyses of these outcomes were not relevant. However, dmft was significantly associated with school SES in bivariate analysis. Putative confounders that were significantly associated with both school SES (**Error! Reference source not found.**) and dmft (**Error! Reference source not found.**) were: use of toothpicks, toothache sometimes to very often during the past 12 months and dental visiting in the past 12 months.

The multivariable model found school SES, toothache, dental visiting in the past 12 months, and age were independently associated with dmft (**Error! Reference source not found.**). The model explained 23% of the variation in dmft (R2 = 0.23, model p-value < 0.001). Children in the mid-high SES group had higher mean dmft than children in the low SES group while children who had visited a dentist in the past year had a higher mean dmft than children who did not visit a dentist. Compared to children aged

6-8 years, children aged 9-11 years had significantly lower mean dmft. Toothache was statistically significant in the model ($p = 0.046$).

Table 5.7. Multivariable regression model for dmft

Variable	Beta (95% CI)	*p*-value
Socio-economic status (Ref = Low)	1.87 (0.92, 2.83)	< 0.001
Toothache (Ref = Never or hardly ever)	0.82 (0.02, 1.62)	0.046
Visted a dentist (Ref = Not during past 12 months)	1.21 (0.32, 2.11)	0.008
Age 9-11 years (Ref = 6-8 years)	-2.67 (-3.42, -1.93)	< 0.001

$R^2 = 0.23$, model p-value < 0.001

5.5 Discussion

The primary dental caries experience was greater in the children from mid to high SES schools compared to low SES schools. This is the opposite of what has been found in other studies in both developed and developing economies (Schwendicke et al 2015). Providing oral health services for people in developing countries is a challenge (Petersen et al 2005) where tooth extraction and oral surgery are considered of greater importance than restorative or preventive treatment **(**FAO 2012). The most probable reason for the association between mid to high SES schools and greater primary dental caries experience is the large increase in sugar imports over the past decade, and since most sugar consumed in Timor-Leste is imported, the large increase in sugar consumption. Data on per capita sugar intake is not available, but sugar imports increased from 756 tonnes/year in 2003 and to 1883 tonnes/year in 2011 (Bourgeois & Llodra 2014). Why primary dental caries experience was higher in children from mid to high compared to low SES schools may be explained by larger disposable incomes in mid to high SES groups, permitting the purchase of food and luxuries with high sugar content.

Our results of dmft of 5.1 in the 6-8 year and 2.2 in the 9-11 year age group can be compared with the dmft in 2013 in other southeast Asia region countries where it was 4.34 for children aged 6 years in Myanmar, 3.82 in children aged less than 11 years in Vietnam, 6.07 in children aged 6 years in Cambodia, and 12.03 in children aged 4 years

in the Philippines (Broadbent & Thomson 1997). Our results were more than those in Myanmar and Vietnam, but less than those in Cambodia and the Philippines. However, primary dental caries experience is increasing in Timor-Leste (Babo Soares et al 2016) and as this higher dental caries experience is likely to flow onto permanent teeth in the future, the country must take action.

These are important results because they show policy makers and dental clinicians they need to implement policies that focus on dental caries prevention, and in the case of Dili school children, not only focusing on low SES schools. Copying the medical model to improve oral health is not feasible in a developing economy. Hence, the approach should be a preventive one using techniques such as oral health promotion for school children, salt fluoridation, fluoride toothpaste, and banning sweet stalls near schools.

The reason why children aged 6-8 years had a higher mean dental caries experience than children of other age groups can be explained by the exfoliation of deciduous teeth. Dental services in Dili was largely problem-based and the fact that children who often or very often had had a toothache, or had visited a dentist in the last 12 months had a high dental caries experience (dmft+DMFT) is explained by the fact that children with higher dental caries experience were more likely to suffer a problem and visit a dentist.

In bivariate analysis, higher dmft was seen in higher SES schools, but there was more toothache, more visits to the dentists in past 12 months, and more calculus in the children from low than mid-high SES schools. This seemingly contradictory result may be explained by low SES school children, though visiting a dentist more often, being more likely visit for a problem while mid-high SES school children may be more likely to visit for a check-up.

There were several limitations with this study. The questionnaires completed by parents or carers could have been subjected to information bias. Children's responses, such as brushing their teeth the day before, may not have aligned with parents' responses and observations. There is also the possibility of positive response bias, where both children and parents over-reported children brushing their teeth the day before, in order to fit with the hygiene expectations of the study team. There are 32 dialects in Timor-Leste. Some local dialects were not included in the study which means some demographic groupings may have been missed. This may diminish demographic variation of the

participant surveyed. It is also possible that the parents or children might have been subjected to recall bias, particularly in relation to reason for the last dental visit and treatment received. It was not possible to assess change in individual sugar consumption in Dili. Low school attendance (42.5%) in the district of Dili may be regarded as a weaknesses of the current study (NSD 2011). It is not unreasonable to predict that children who do not attend school would have a lower knowledge of oral hygiene and lower sugar consumption. The limitations of the DMFT Index include that the values do not provide any indication of the number of teeth at risk or data that is useful in estimating treatment needs; that the index gives equal weight to missing, untreated decay, or well restored teeth; that the index does not account for teeth lost for reasons other than decay (such as trauma); and that it does not account for sealed teeth since sealants and cosmetic restorations did not exist in the 1930s when this method was developed (Burt 1997). However, as treatment in Dili was problem-based, the issues of sealants and other cosmetic restorations is not relevant to this study. The same SES criteria was used for the Moslem school as for the other schools and differences may be attributable to religious and cultural differences rather than high/low SES status. However, there were many students of catholic and other backgrounds studying in the Moslem school which would have alleviated this potential limitation.

Strengths of the study included that it used a large, randomised sample. The study recruited 40 schools to participate, which is 37% of all schools in Dili. The study provides an important contribution to the oral health profile in two different SES school groups, a topic that has not been investigated previously.

Further research needs to be undertaken to further identify groups of children most vulnerable to dental caries within Dili and Timor-Leste, such as those with high sugar consumption. Researchers need to question why the SES profile of oral health in Dili children is different to that in other developing economies. There is also a need to develop oral health policies suitable for the Timor-Leste situation, such as oral health promotion targeted at particular demographic groups, salt fluoridation, supplying affordable toothbrushes and toothpaste, school-based dental health education and screening, and fluoride and fissure sealant programs.

5.6 Conclusion

Primary dental caries experience in 2014 was greater among children from mid-high SES schools than from low SES schools, a fact which may be explained by higher sugar consumption.

5.7 Postscript

In this chapter, the association between school socio-economic status and dental caries experience of schoolchildren residing in the Dili district was described. The study demonstrated that the primary dental caries experience in 2014 was greater among children from mid-high SES schools than from low SES schools, possibly owing to high sugar consumption.

Chapter 6

Parental Education Level and the Prevalence of Untreated Decaying Teeth in Children Living in Dili, Timor-Leste

6.1 Preface

The association between school SES and dental caries experience in primary teeth was demonstrated in the previous chapter. In this chapter, the association between parental education level and the prevalence of untreated carious primary and permanent teeth (d&D) in children of Dili, Timor-Leste is investigated. Most of the text that follows has been submitted for publication. Babo Soares L, Allen P, Bettiol S, Crocombe L. 'Parental education level and the prevalence of untreated decaying teeth in children living in Dili, Timor-Leste', *WHO South-East Asia Journal of Public Health* 2016.

6.2 Introduction

Oral health is an integral component of health and wellbeing at every stage of life and childhood is an important time of establishing lifelong healthy habits. The impact of oral diseases on non-communicable diseases (NCDs) in terms of reduced quality of life, increased cost of treatment, pain and suffering is considerable (FDI 2013). The common risk factors for oral disease are influenced by tobacco, sugar intake, diet, fluoride exposure and excessive alcohol consumption, but oral disease is also significantly influenced by socio-economic determinants.

The Democratic Republic of Timor-Leste (East Timor) became an independent nation in 2002 but has since struggled with persistent poverty and inequality (Saikia et al 2011). The health system of Timor-Leste, as well as its social and economic indicators, remain bound by the nation's history and precedent. After an independence referendum in 1999, the pro-Indonesian militia backed by the Indonesian military destroyed 80% of schools and health clinics, and displaced one third of the population (Saikia et al 2011). This coupled with a projected threefold increase in the population between 2005 and 2050, (Saikia et al 2011) gives an indication of the health service delivery problems faced by the Timor-Leste government.

There are few, if any, records available on the dental health of the people of Timor-Leste prior to 2002 when a National Oral Health Survey (AusAID 2002) reported that most decayed teeth were untreated. A follow-up survey in 2014 (Babo Soares et al 2016) found that the dental caries experience (dmft+DMFT) was significantly greater in 2014, among Dili school children, compared to 2002, possibly related to the large increase in the sugar imports and consumption in Timor-Leste during the intervening period.

In developing economies, dental caries is often left untreated or teeth are removed due to limited access to oral health services (WHO 2003). In Australia, the mean number of teeth with untreated dental caries in primary and permanent dentition decreased with increasing socio-economic status (SES) of children attending school dental service (Ha et al 2014). Gift and co-authors (1996) had a similar result with a population of US adults aged 18 years or older. In a systematic review, the prevalence of untreated dental caries was found to be higher in low compared to high SES groups in both developed and developing economies (Schwendicke et al. 2015).

The reasons why socio-economic factors are associated with oral health are still open to debate. Sanders and Spencer conjectured that socio-economic factors do not account for observed health differences directly, but rather are marking other genetic, social and psychological phenomena that drive variation in health (Sanders and Spencer, 2004). Armfield (2005) described how education influences inequality in health in a number of ways. Firstly, it has a significant role in influencing socioeconomic position, being a determinant of a person's labour market position which in turn influences income, housing and other material resources. Second, education prepares children for life by enabling practical, social and emotional knowledge for achieving a full and healthy life. Third, education plays a role in preparing people for participating in society, teaching about rights and responsibilities and educating people in regards to the use and availability of services.

As Timor-Leste rebuilds its health system, providing oral health services will be a challenge, as it is for many developing countries (Petersen et al 2005). Determining the relationship between parental education level and untreated dental caries prevalence in Timor-Leste will help enable policy makers and dental clinicians make recommendations and develop appropriate oral health policies for school-age children.

The aim of this paper is to investigate the association between parental education level and the prevalence of untreated carious primary and permanent teeth in children of Dili, Timor-Leste.

6.3 Methods

The 2014 oral health survey of Dili's children replicated the methods described by Roberts-Thomson and colleagues in the AusAID report (AusAID 2002). Ethical approval for the research was granted by the University of Tasmania Human Research Ethics Committee (reference H13216). This study was a sub-study of a larger comparative cross-sectional epidemiological survey (conducted in 2002 and 2014) of the oral health of Dili's children.

6.3.1 Study Design

Cross-sectional epidemiological survey of the oral health of Dili's children.

6.3.2 Study Population

Children aged 6-17 years enrolled in primary, junior and senior high schools in the district of Dili in 2014.

6.3.3 Sampling Strategy

The survey sampling strategy was based upon the sampling strategy of the 2002 survey (AusAID 2002): Four sub-districts were randomly selected: Dom Aleixo, Cristo Rei, Metinaro and Vera Cruz. The number of primary schools, junior high schools and senior high schools invited to participate within each sub-district was proportional to the population size of the sub-district.

6.3.4 Recruitment

Recruitment took place within 40 schools, with students randomly selected and invited to participate. Equal numbers of children were invited to participate from four age strata (6–8, 9–11, 12–14 and 15–17 years). Children were provided with a study information sheet and consent form to take home for their parent or legal guardian to read and complete. One week later, the study team visited the school to undertake the surveys and oral examinations. All parents/guardians provided written consent for their child to

participate and the children were accompanied by their parent/guardian for the survey and oral examination.

6.3.5 Participants

Participants were children aged 6 to 17 years who were attending the participating schools.

6.3.6 Data Collection

A questionnaire was used to collect data on demographics and oral health behaviours. The questionnaire obtained information on tooth brushing, use of toothpaste, time since last dental visit, reason for that visit, the type of professional visited and treatment received. For those parents/guardians who were illiterate, the questionnaire was orally administered by a member of the research team during the school data collection visit.

Oral epidemiological examinations were conducted by dental health professionals (four dentists and five dental nurses) who had completed a five-day training in oral examination. Dental nurses in Timor-Leste are trained to do extractions and basic resorations. It was impractical to use only dentists for the data collection, due to their small numbers in Timor-Leste. Oral examinations were conducted in school classrooms with parents/guardians invited to accompany their child throughout. Children were seated in a proclined position and natural sunlight was used. The examination collected information on the number of teeth present, caries prevalence and severity, gingival condition and the presence of calculus. Children's dental status was scored using the prevalence of both decayed deciduous and permanent teeth (d+D). Periodontal status was assessed using calculus and bleeding indices (WHO 1997).

6.3.7 Parental Education Level

Information on education level was collected for mothers and fathers. The oral health behaviours questionnaire listed five levels of education: no schooling, elementary school, junior high school, senior high school and college or tertiary education. Highest household parental education was based on either the mother or father's education level, whichever was higher. Parental education level was then dichotomosied into no formal education/low level or senior high school or above.

6.3.8 Data Analysis

The data was imported into SPSS version 23 for analysis. Children who did not participate in both the quesionnairre and the oral examination were excluded. The prevalence of decay was investigated in deciduous teeth (d), permanent teeth (D) and both deciduous teeth plus permanent teeth (d+D). For this calculation, a child was categorised as having tooth decay if untreated decay was present in either the delicious or permanent teeth.

Chi-square tests were used to investigate the association between the prevalence of decay (in deciduous teeth [d] + permanent teeth [D]) and parental education level, and between decay and putative confounders. Standardised residuals of crosstabs were calculated to identify cells where there were significantly fewer, or significantly greater, than expected participants. Variables that were associated with parental education level and decay were considered confounders and included in a multivariable multivariable logistic regression with the prevalence of decay (d+D) as the dependent variable and age group as a covariate (with age 15-17 years as the reference category). The regression model was validated through checking the distribution of the residuals, and investigating collinearity diagnostics and Cook's distance measures. All tests were two-sided and differences were accepted as significant at alpha 0.05 level.

6.4 Results

6.4.1 Descriptive Results

Among the 758 interview participants there was no significant difference in the proportion of females compared with that reported in the census (.49 vs .49, $p = 0.51$). There was also no difference in the proportion of males who participated in the oral examination compared with the census data (.51 vs .51, $p = 0.47$). A smaller number of children (n = 655) were recruited to the oral examination component. Some children were absent from school on the day of the oral examination and some were unwilling to participate in this component of the research. The 103 children who did not have an oral examination were excluded from further analyses.

There were 467 (71.2%) children who had a mother or father with senior high school or above education level (Table 6.1).

Table 6.1. Highest household education level among oral examination sample (n = 655) (data weighted to Dili 2010 Census population)

Education Level	Mother or Father n (%)
No schooling	26 (4.0)
Elementary school	71 (10.8)
Junior high school	92 (14.0)
Senior high school	273 (41.7)
College or tertiary	193 (29.5)
Total	***655 (100.0)***

Almost all the parents/guardians (n = 636, 97.1%) reported that their children had brushed their teeth the previous day, while 36.7% (n = 240) of the children suffered from toothache (sometimes to very often) during the previous 12 months, 32.7% (n = 214) reported being unhappy about the appearance of their teeth and 45.2% (n = 296) had ever visited a dentist. A quarter (25.0%) of the children had visited a dentist in the previous 12 months.

Most of the children exhibited gingival bleeding (n = 423, 64.6%) and calculus (n = 374, 57.1%). The prevalence of decay was 38.8% (n = 254) in deciduous teeth (d), 69.5% (n = 455) in permanent teeth (D) and 87.5% (n = 573) in the deciduous or permanent teeth (d+D).

6.4.2 Bivariate Analysis

In bivariate analyses, there was no association between parental education level and the prevalence of untreated decay in deciduous teeth (d) (χ^2 (1) = 0.003, p = 0.96). However, there was an association between parental education level and the prevalence of untreated decay (D) in the permanent teeth (χ^2 (1) = 4.74, p = 0.03) and in prevalence of untreated decay overall (d+D) (χ^2 (1) = 7.28, p = 0.007) where the prevalence was higher in children of parents of lower than higher education levels.

Table 6.2. The association between parental education level and decay (d, D, and d+D) (n = 655, data weighted to Dili 2010 Census population)

Variable	No/low level parental education n = 188 % (95% CI)	Senior high school or above parental education n = 467 % (95% CI)	*p*-value
Decay in deciduous teeth (d)	38.6 (31.6, 46.0)	38.8 (34.4, 43.4)	0.96
Decay in permanent teeth (D)	75.7 (68.9, 81.6)	67.0 (62.6, 71.3)	0.03
Decay in deciduous or permanet teeth (d+D)	93.1 (88.5, 96.3)	85.4 (81.9, 88.5)	0.007

Note: *Weighting of data results in slight changes in the number of participants in each group across each bivariate test. To avoid confusion, percentages only are reported.*

There was no association between sex and the prevalence of untreated decay in deciduous teeth (d) (38.8% in girls and 38.7% in boys, χ^2 (1) = 0.00, p = 0.99) or permanent teeth (D) (71.6% in girls and 67.6% in boys, χ^2 (1) = 1.24, p = 0.27). There was also no association between sex and the prevalence of untreated decay in deciduous and permanent teeth (d+D) (89.4% in girls and 85.7% in boys, χ^2 (1) = 2.05, p = 0.15).

The proportion of children with decayed deciduous teeth was higher among those aged 6-8 years compared to 9-11 year olds. There was an association between using toothpicks and a lower prevalence of decayed deciduous teeth. However, no other variables were associated with the prevalence of untreated decay in the deciduous teeth.

Table 6.3. Bivariate analysis of dental caries prevalence in the deciduous teeth **d** and putative confounders (n = 655, data weighted to Dili 2010 Census population)

Variable	d Prevalence % (95% CI)	*p*-value
Age Group		
6-8 years	83.2 (76.9, 88.3)	< 0.001
9-11 years	57.8 (49.7, 65.5)	
12-14 years	-	-
15-17 years	-	-

Variable	d Prevalence % (95% CI)	*p*-value
Tooth Brushing		
Did not brush teeth yesterday	52.6 (28.9, 75.6)	0.21
Brushed teeth yesterday	38.4 (34.6, 42.2)	
Toothpicks		
Does not use toothpicks	50.0 (43.7, 56.3)	< 0.001
Uses toothpicks	31.6 (27.0, 36.4)	
Unhappy With Appearance Of Teeth		
Never or hardly ever	36.8 (32.0, 41.8)	0.71
Sometimes to very often	38.3 (31.8, 45.2)	
Toothache		
Never or hardly ever	35.4 (30.4, 40.6)	0.18
Sometimes to very often	40.8 (34.6, 47.3)	
Avoid Eating Due To Tooth Pain		
Never or hardly ever	38.0 (33.1, 43.1)	0.32
Sometimes to very often	33.8 (27.3, 40.8)	
Ever Visited A Dentist		
No	41.1 (35.9, 46.4)	0.19
Yes	36.0 (30.6, 41.8)	
Visted A Dentist During Past 12 Months		
Not during past 12 months	36.8 (32.5, 41.2)	0.07
During past 12 months	44.8 (37.0, 52.8)	
Reason For Dental Visit		
Check-up	32.1 (15.9, 52.4)	0.52
Problem (pain, decay, bleeding or trauma)	38.5 (32.2, 45.0)	
Treatment		
Check-up or other treatment	40.5 (33.0, 48.3)	0.23
Extraction	33.0 (23.6, 43.4)	

Variable	d Prevalence % (95% CI)	*p*-value
Gingival Bleeding		
No	34.9 (28.8, 41.4)	0.13
One or more sites	40.9 (36.2, 45.8)	
Calculus		
No	41.3 (35.5, 47.3)	0.26
At one or more sites	36.9 (32.0, 42.0)	

Children who reported using toothpicks had a lower prevalence of decay in the permanent teeth (D) compared to children who did not use toothpicks (Table 6.3). Children who had were unhappy with the appearance of their teeth, who had toothache or avoided eating, sometimes to very often during the past 12 months, had a higher prevalence of untreated decay in permanent teeth. Children who had ever visited a dentist and those who last visited a dentist due to a problem (pain, decay, bleeding or trauma) also had a higher prevalence of decayed permanent teeth (D). Both gingival bleeding and calculus were also associated with decayed permanent teeth (D).

Table 6.4. Bivariate analysis of dental caries prevalence in the permanent teeth **D** and putative confounders (n = 655, data weighted to Dili 2010 Census population)

Variable	D Prevalence % (95% CI)	*p*-value
Age Group		
6-8 years	-	-
9-11 years	-	-
12-14 years	79.4 (71.8, 85.8)	0.07
15-17 years	87.1 (81.1, 91.7)	
Tooth Brushing		
Did not brush teeth yesterday	73.7 (48.8, 90.9)	0.69
Brushed teeth yesterday	69.3 (65.6, 72.9)	
Toothpicks		
Does not use toothpicks	64.5 (58.3, 70.3)	0.03
Uses toothpicks	72.7 (68.0, 77.0)	
Unhappy With Appearance Of Teeth		
Never or hardly ever	66.8 (61.9, 71.5)	0.008
Sometimes to very often	77.1 (70.9, 82.6)	
Toothache		
Never or hardly ever	64.9 (59.7, 69.8)	0.001
Sometimes to very often	77.9 (72.1, 83.0)	
Avoid Eating Due To Tooth Pain		
Never or hardly ever	65.6 (60.6, 70.4)	< 0.001
Sometimes to very often	80.6 (74.4, 85.8)	
Ever Visited A Dentist		
No	65.7 (60.6, 70.6)	0.02
Yes	74.0 (68.6, 78.9)	

Variable	D Prevalence % (95% CI)	*p*-value
Visted A Dentist During Past 12 Months		
Not during past 12 months	68.8 (64.5, 72.9)	0.55
During past 12 months	71.3 (63.8, 78.1)	
Reason For Dental Visit		
Check-up	50.0 (30.6, 69.4)	0.001
Problem (pain, decay, bleeding or trauma)	79.1 (73.3, 84.1)	
Treatment		
Check-up or other treatment	72.2 (64.8, 78.8)	0.08
Extraction	81.9 (72.6, 89.1)	
Gingival Bleeding		
No	60.3 (53.7, 66.7)	< 0.001
One or more sites	74.7 (70.3, 78.8)	
Calculus		
No	60.5 (54.5, 66.3)	< 0.001
At one or more sites	76.2 (71.6, 80.4)	

There was an association between age and the prevelance of untreated decay in deciduous and permanent teeth (d+D), with a lower than expected proportion of 12-14 year olds having untreated decay (Table 6.5). Children who reported being unhappy with the appearance of their teeth, having had a toothache or avoiding eating due to tooth pain, sometimes to very often during the past 12 months had a higher prevalence of untreatecd decay. A greater proportion of children who had ever visited a dentist, who had visited a dentist in the last 12 months or who had visited a dentist due to a problem (pain, decay, bleeding or trauma) had decay in their deciduous or permanent teeth (d+D). There was also greater d+D prevalence among children who had gingival bleeding.

Table 6.5. Bivariate analysis of dental caries prevalence in the deciduous and permanent teeth (d+D) and putative confounders (n = 655, data weighted to Dili 2010 Census population)

Variable	d+D Prevalence % (95% CI)	*p*-value
Age Group		
6-8 years	91.8 (86.8, 95.3)	0.02
9-11 years	89.4 (83.6, 93.7)	
12-14 years	80.7 (73.2, 86.9)	
15-17 years	87.1 (81.1, 91.7)	
Tooth Brushing		
Did not brush teeth yesterday	94.7 (74.0, 99.9)	0.33
Brushed teeth yesterday	87.3 (84.4, 89.8)	
Toothpicks		
Does not use toothpicks	90.2 (85.9, 93.6)	0.11
Uses toothpicks	86.0 (82.2, 89.2)	
Unhappy With Appearance Of Teeth		
Never or hardly ever	85.5 (81.6, 88.9)	0.02
Sometimes to very often	92.1 (87.6, 95.3)	
Toothache		
Never or hardly ever	83.9 (79.7, 87.5)	0.001
Sometimes to very often	93.3 (89.4, 96.1)	
Avoid Eating Due To Tooth Pain		
Never or hardly ever	84.6 (80.6, 88.1)	0.004
Sometimes to very often	93.0 (88.6, 96.1)	
Ever Visited A Dentist		
No	85.0 (80.8, 88.5)	0.03
Yes	90.6 (86.7, 93.6)	

Variable	d+D Prevalence % (95% CI)	*p*-value
Visted A Dentist During Past 12 Months		
Not during past 12 months	86.0 (82.6, 88.9)	0.04
During past 12 months	92.1 (86.8, 95.7)	
Reason For Dental Visit		
Check-up	82.1 (63.1, 93.9)	0.02
Problem (pain, decay, bleeding or trauma)	94.0 (90.2, 96.7)	
Treatment		
Check-up or other treatment	92.9 (87.9, 96.3)	0.83
Extraction	93.5 (86.5, 97.6)	
Gingival Bleeding		
No	82.3 (76.8, 87.0)	0.003
One or more sites	90.3 (87.1, 93.0)	
Calculus		
No	85.1 (80.3, 89.0)	0.10
At one or more sites	89.3 (85.7, 92.2)	

There was an association between age group and parental education level. A significantly lower than expected proportion of children whose parents had no or low education were in the 12-14 years age group (**Error! Reference source not found.**). There was also an association between parental education level and children reporting toothache (sometimes to very often during the past 12 months), being unhappy about the appearance of their teeth and avoiding eating due to tooth pain (sometimes to very often during the past 12 months). There were no associations between parental education level and children ever visiting a dentist or visiting during the past 12 months. However, children whose parents had low education levels were more likely to have visited a dentist due to a problem (e.g. decay, pain, bleeding or trauma). There was no association between the parental education and the presence of calculus or gingival bleeding.

Table 6.6. Bivariate analysis of parental education level and putative confounder (data weighted to 2010 Census)

	No/low level parental education n = 188 % (95% CI)	Senior high school or above parental education n = 467 % (95% CI)	*p*-value
Age group			
6-8 years	30.9 (24.3, 38.0)	27.0 (23.1, 31.3)	0.003
9-11 years	22.9 (17.1, 29.5)	25.1 (21.2, 29.3)	
12-14 years	13.3 (8.8, 19.0)	24.7 (20.8, 28.9)	
15-17 years	33.0 26.3, 40.2)	23.2 (19.4, 27.3)	
Brushed teeth yesterday	95.2 (91.2, 97.8)	97.9 (96.1, 99.0)	0.07
Use of toothpicks	56.4 (49.0, 63.6)	62.7 (58.2, 67.1)	0.13
Toothache (sometimes to very often)	51.5 (43.7, 59.2)	35.4 (30.9, 40.2)	< 0.001
Unhappy about appearance of teeth (sometimes to very often)	43.5 (35.8, 51.3)	32.6 (28.2, 37.3)	0.01
Avoid eating due to tooth pain (sometimes to very often)	46.3 (38.5, 54.3)	29.7 (25.4, 34.3)	< 0.001
Ever visted a dentist	47.1 (39.8, 54.5)	44.5 (40.0, 49.2)	0.55
Visted a dentist during past 12 months	29.6 (23.2, 36.7)	23.1(19.4, 27.2)	0.08
Visted a dentist due to a problem last visit	96.1 (89.0, 99.2)	87.0 (81.2, 91.5)	0.03
Extraction at last dentist visit	36.4 (25.7, 48.1)	35.3 (28.4, 42.7)	0.87
Gingival bleeding	63.5 (56.2, 70.4)	65.0 (60.5, 69.4)	0.71
Calculus	59.8 (52.4, 66.8)	56.0 (51.4, 60.6)	0.37

6.4.3 Multivariable Analyses

As the prevalence of decay in the deciduous teeth (d) was not associated with parental education level, this was not included in multivariable modelling. Two separate multivariable models were produced to investigate the association between parental education level, putitative confounders and the prevalence of: 1) untreated decay in the permanent teeth (D) and 2) untreated decay in the deciduous or permanent teeth (d+D).

Multivariable of variables associated with decay in the permanent teeth model 1

Variables that were significantly associated with both the prevalence of untreated decay in permanent teeth (D) (**Error! Reference source not found.**) and parental education (Table 6.2) were: children being unhappy with the appearance of their teeth, toothache, avoiding eating (all sometimes to very much during the past 12 months) and last visiting a dentist due to a problem (pain, decay, bleeding or trauma). Parental education level was entered as a covariate and age group was added to the model due to children having mixed dentition within the 6-11 age groups. Untreated decay in permanent teeth (D) was the dependent variable.

The first multiavariable model included 239 children and was significant overall (Nagelkerke R^2 = .22, p < 0.001). There were 416 children excluded from the model due to missing data on the reason for last dental visit. The reason for this large volume of missing data was due to 54.8% of children had never previously visited a dentist. A small number of children were excluded from the model as they or their parent or guardian could not recall the reason for their last dentist visit.

The multivariable model identified last dentist visit due to a problem and age as independently associated with untreated decay in the permanent teeth (D) (Table 6.6). Children who last visited a dentist due to decay, pain, bleeding or trauma were 3.6 times more likely to have decay in permanent teeth detected at the oral examination. There was also an increasing prevalence of untreated tooth decay with age. Compared to children aged 6-8 years, children aged 9-11 years were 2.3 times more likely to have decayed permanent teeth, children aged 12-14 years 5.0 times more likely and children aged 15-17 years 13.3 times more to have decayed permanent teeth. Other variables associated with decayed permanent teeth in bivariate analyses, including parental education level, were not independently associated with untreated tooth decay (D).

Table 6.7. Multivariable model of the association between demographic and oral health behaviours with decay in the permanent teeth **D** (n = 239, data weighted to 2010 Census)

Variable	B	S.E.	*p*-value	Exp(β) (95% CI)
Last dentist visit due to a problem (pain, decay, bleeding or trauma)	1.29	0.51	0.01	3.64 (1.33, 9.98)
Age group*				
9-11 years	0.82	0.42	0.048	2.28 (1.01, 5.13)
12-14 years	1.61	0.46	0.001	5.00 (2.02, 12.37)
15-17 years	2.59	0.54	< 0.001	13.32 (4.60, 38.57)

***Note:** children aged 6-8 years were the reference category*

Multivariable of variables associated with decay in the permanent teeth model 2

Due to the large number of children with no information available for the reason for last dentist visit (due to more than half the sample never visiting a dentist), a second model was investigated with the same variables as model 1 but excluding last visit to a dentist due to a problem.

Variables that were enetered into the model were: children being unhappy with the appearance of their teeth, toothache and avoiding eating (all sometimes to very much during the past 12 months). Parental education level was entered as a covariate and age group was added to the model due to children having mixed dentition within the 6-11 age groups. Decay in permanent teeth (D) was the dependent variable.

The second multivariable model included 567 children and was significant overall (Nagelkerke $R^2 = .21$, $p < 0.001$). The model included toothache, parental education level and age (**Error! Reference source not found.**). Children who had toothache sometimes to very much during the past 12 months were 2.1 times more likely to have decayed permanent teeth. While parental education level was in the final model, it was not significant ($p = 0.09$). Compared to children aged 6-8 years, those aged 9-11 years were 3.3 times more likely, children aged 12-14 years were 5.3 times more likely and those aged 15-17 years were 9.2 times more likely to have decay in the permanent teeth (D).

Table 6.8. Multivariable model of the association between demographic and oral health behaviours with decay in the permanent teeth **D** excluding reason for last dentist visit (n = 567, data weighted to 2010 Census)

Variable	B	S.E.	*p*-value	Exp(β) (95% CI)
Toothache (sometimes to very much during the past 12 months)	0.72	0.22	0.001	2.05 (1.35, 3.13)
Parental education level (senior high school or higher)	-0.41	0.24	0.09	0.67 (0.42, 1.06)
Age group*				
9-11 years	1.19	0.26	< 0.001	3.29 (1.99, 5.44)
12-14 years	1.67	0.28	< 0.001	5.30 (3.04, 9.24)
15-17 years	2.21	0.31	< 0.001	9.15 (5.03, 16.65)

***Note:** children aged 6-8 years were the reference category*

Multivariable of variables associated with decay in the deciduous and permanent teeth (d+D) model 1

Variables that were significantly associated with both the prevalence of decay in the deciduous or permanent teeth (d+D) (**Error! Reference source not found.**) and parental education (**Error! Reference source not found.**) were: children being unhappy with the appearance of their teeth, toothache, avoiding eating (all sometimes to very much during the past 12 months) and last visiting a dentist due to a problem (pain, decay, bleeding or trauma). Parental education level was entered as a covariate and age group was added to the model due to children having mixed dentition within the 6-11 age groups. Decay in deciduous or permanent teeth (d+D) was the dependent variable.

There were 239 children in the model and was significant overall (Nagelkerke R^2 = .11, p = 0.02). Similarly to the multivariable model of the prevalence of decay in the permanent teeth (D), the final multivariable model of decay in the deciduous or permanent teeth (d+D), included last dentist visit due to a problem and age as independently associated with decay in the permanent teeth (d+D) (**Error! Reference source not found.**).

Children who last visited a dentist due to decay, pain, bleeding or trauma were 3.8 times more likely to have decay in deciduous or permanent teeth detected at oral examination. Compared to children aged 6-8 years, children aged 9-11 years and 15-17 years did not have signficiantly greater decay (d+D). However, children aged 12-14 years were less likely to have decayed deciduous or permanent teeth. Other variables associated with decayed deciduous+permanent teeth in bivariate analyses, including parental education level, were not included in the final model.

Table 6.9. Multivariable model of the association between demographic and oral health behaviours with decay in the deciduous or permanent teeth (d+D) (n = 239, data weighted to 2010 Census)

Variable	B	S.E.	*p*-value	Exp(β) (95% CI)
Last dentist visit due to a problem (pain, decay, bleeding or trauma)	1.32	0.60	0.03	3.75 (1.17, 12.06)
Age group*				
9-11 years	-1.31	1.06	0.22	0.27 (0.03, 2.15)
12-14 years	-2.05	0.99	0.04	0.13 (0.02, 0.90)
15-17 years	-1.19	1.03	0.25	0.31 (0.04, 2.29)

***Note**: children aged 6-8 years were the reference category*

Multivariable of variables associated with decay in the deciduous and permanent teeth (d+D) model 2

Due to the large number of children with no information available for the reason for last dentist visit (as more than half the sample never visiting a dentist), a second model was investigated with the same variables as model 1 but excluding last visit to a dentist due to a problem.

Variables entered into the second model were: children being unhappy with the appearance of their teeth, toothache, avoiding eating (all sometimes to very much during the past 12 months) and last visiting a dentist due to a problem (pain, decay, bleeding or trauma). Parental education and age group were entered as covariates and the dependent variable was decay in deciduous or permanent teeth (d+D).

The second multivariable model of d+D included 567 children and was significant overall (Nagelkerke R^2 = .1, p < 0.001). The model identified toothache, age and parental education level as independently associated with decay in the deciduous or permanent teeth (d+D) (Table 6.10).

Children who had toothache sometimes to very much during the past 12 months were 2.4 times more likely to have decay in the deciduous or permanent teeth. Compared to children aged 6-8 years, children aged 12-14 years were approximately 61% less likely to have decay (d+D). Children whose parents had a senior high school or above education level were approximately 51% less likely to have decay.

Table 6.10. Multivariable model of the association between demographic and oral health behaviours with decay in the deciduous or permanent teeth (d+D) reason for last dentist visit not included in model (n = 567, data weighted to 2010 Census)

Variable	B	S.E.	*p*-value	Exp(β) (95% CI)
Toothache (sometimes to very much during the past 12 months)	0.89	0.31	0.004	2.44 (1.33, 4.48)
Parental education level (senior high school or higher)	-0.71	0.36	0.048	0.49 (0.24, 0.99)
Age group*				
9-11 years	-0.26	0.42	0.54	0.77 (0.34, 1.76)
12-14 years	-0.95	0.38	0.01	0.39 (0.18, 0.82)
15-17 years	-0.51	0.40	0.20	0.60 (0.28, 1.31)

***Note:** children aged 6-8 years were the reference category*

6.5 Discussion

The prevalence of untreated carious teeth was greater in the children of Dili who had parents with lower than higher education levels. This is similar to what has been found in other studies in both developed and developing economies (Pitts et al 2011; Do 2012; Schwendicke et al. 2015). This is an important result because it allows policy makers and researchers investigate why this is so, and to make policies that will reduce the prevalence of untreated tooth decay in children of parents with lower education levels.

Providing oral health services is a challenge in developing countries (Petersen et al 2005) where tooth extraction and oral surgery have obtained greater importance than restorative or preventive treatment (Hooseinpoor et al 2012).

A previous (unpublished but accepted) study has shown that children from mid-high SES schools have a higher dental caries experience (dmft) than those from low SES schools, possibly due to differing dietary intake and higher sugar consumption (Babo Soares et al 2016). The higher prevalence of untreated carious teeth in children of parents with lower compared to higher education levels and that the Timor-Leste Dental Service focuses on providing care to children from low SES schools, indicates that parents with low education levels do not see oral health as important, suggesting that access to oral health information or health literacy remains poor, resulting in problem-based dental visiting. This premise is supported by the fact that parental education level was associated with last visiting a dentist due to a problem (pain, decay, bleeding or trauma).

This result is important because it also indicates that the Timor-Leste Dental Service, even with its focus on low SES schools, continues to have difficulty supplying dental care to children of parents with low education levels. Parents with low education levels would have more difficulty affording private dental care for their children than parents with high education levels because education is assoxciated with income in Dili. The lack of staff in the Timor Leste Dental Service makes supllying adequate dental care very difficult. Another result that was important was that because children who were unhappy with the appearance of their teeth, who had toothache or avoided eating, sometimes to very often during the past 12 months, were more likely to both have a higher prevalence of untreated decay and parents of low education levels. These results will help policy makers and dental clinicians make recommendations and develop appropriate oral health policies for school-age children.

The low level of school attendance (42.5%) in the district of Dili may be regarded as a weaknesses of the current study (GOTL 2010). It is not unreasonable to predict that children who are not attending school would be poorer, have a lower knowledge of oral hygiene, lower sugar consumption and reduced access to dental care. However, a household based survey to assess the oral health of children was not an option due the considerable costs and resources associated with the method. School-based study

recruitment was the only pragmatic option available to the researchers. The prevalence of untreated dental caries measure does not account for some children who may have a much higher number of untreated carious teeth than others. However, when the analysis was redone using the mean number of carious teeth per child, the results were similar to that found for dental caries prevalence.

Strengths of the study included that it used a randomised sample, data was collected using a validated oral health assessment tool and all of the oral health professionals who collected data participated in extensive training on the tool. The study also recruited a sufficiently large number of children to test the study hypothesis. The study provided an important contribution to the dental caries prevalence in two different parental education level groups.

In performing this work there were several limitations that need to be highlighted. Firstly, there are 32 dialects in Timor-Leste and the study was completed in Tetum. Some local dialects were not included in the study, which means some demographic groupings may have been missed. This may diminish demographic variation of the participants surveyed. It is possible that the parents or children might have been subjected to recall bias or positive response bias in relation to oral health behaviours and dental visiting. The questionaries were completed by parents or carers on behalf of children, which may also have resulted in information bias.

Further research needs to be undertaken to further identify the children most vulnerable to untreated dental caries within Dili and Timor-Leste, such as those with high sugar consumption and to develop oral health policies suitable for the Timor-Leste situation. Such policies may include oral health promotion targeted at particular demographic groups, salt fluoridation, supplying affordable toothbrushes and toothpaste, school-based dental health education and screening, and fluoride and fissure sealant programs.

6.6 Conclusion

The untreated dental caries prevalence was greater in the children with parents with lower education levels than for children with parents with higher education levels in Dili in 2014.

6.7 Postscript

In this chapter, the association parental education level and the prevalence of untreated dental caries (d+D) in primary and permanent teeth in children of Dili, Timor-Leste was identified. Previous studies in other countries have indicated a high level of untreated dental caries in children of the low parental education group. Our result agreed with previous studies.

The next chapter (Chapter 7), describes oral health policy and practice from 2002 to the present time and proposes future oral health policy directions for Timor Leste.

Chapter 7

Opportunities in Oral Health Policy for Timor-Leste

7.1 Preface

The association between parental education level and the prevalence of untreated dental caries in primary and permanent teeth in children of Dili was investigated in the previous chapter **(Chapter 6).** The previous studies in Chapters 4 & 5 revealed greater dental caries experience in Dili school children in 2014 than 2002 and a higher primary teeth dental caries experience in children from mid-high rather than low SES Dili schools.

In this chapter, a review of the oral health policy and practice in Timor-Leste from 2002 to the present and propose ways forward are presented. A report based on the material presented in this chapter has been published in a peer-reviewed journal: Babo Soares L, Bettiol S, Dalla-Fontana IJ, Allen P, Crocombe L. Oral health policy opportunities for Timor-Leste. *WHO South-East Asia Journal of Public Health.* September 2016, 5(2): 164-173 (Appendix 16).

7.2 Background

Oral health is an important component of general health and quality of life (Taylor 2001). The fledgling nation of Timor-Leste faces an urgent set of challenges in oral health. Periodontal disease and oral cancer are associated with entrenched habits of smoking tobacco and chewing betel nut. There is also a heightened risk of dental caries associated with shifting dietary habits, limited fluoride exposure and inadequate provision of preventive dental treatment (AusAID 2002).

By the time of independence in 1999, the administration in Timor-Leste had collapsed; over one third (35%) of all health facilities and 80% of schools were destroyed, the remaining infrastructure was severely damaged and there had been an exodus of doctors, dental professionals and skilled health-management staff (Tulloch et al 2003; Wold Bank 2002). This, coupled with a projected threefold increase in the population

between 2005 and 2050, (Bulato at al 2008) gave an indication of the problems in health-service delivery faced by the new Government of Timor-Leste.

To obtain the profile of oral-health status of the people and to aid the subsequent development of a National Oral Health Strategy, the Australian Agency for International Development (AusAID) funded the National Oral Health Survey in 2002, the first such survey undertaken in Timor-Leste (AusAID 2002). The study identified that the vast majority (>85%) of children and adults had never made a dental visit. Fewer than half the adults who reported having done so had visited a dentist or dental nurse, with the remainder visiting traditional healers (AusAID 2002). The burden of dental caries was found to be low to moderate, probably linked to a subsistence farming diet, but the disease was usually untreated or treated by extractions (AusAID 2002). The prevalence of smoking among male adults was above 70%, and more than one third (38.3%) of adults of both sexes chewed betel nut. (AusAID 2002).

The United Nations Transitional Administration ended when Timor-Leste became an independent nation on 20 May 2002 (Tulloch et al 2003). At the end of 2002, there were two dentists and 39 dental nurses working in the country. By 2013, there were seven dentists and 40 dental nurses, with one dental nurse per 27 018 people (GOTL 2011). As of 2016, there were 10 public- and private-sector dentists in Timor-Leste. The present paper reviews the policy and practice relevant to oral health in Timor-Leste from 2002 to the present, and proposes ways forward.

7.3 Previous Policy Recommendations for Oral Health Related to Timor-Leste

7.3.1 National Oral Health Survey, Timor-Leste, 2002

Recommendations on oral-health policy (**Error! Reference source not found.**) from the 2002 National Oral Health Survey included the integration of oral-health promotion with general health promotion, and monitoring of the oral health of infants and children younger than school age, as a component of general health check-ups (AusAID 2002). It recommended that non-acidic and low-sugar fluids should be promoted for consumption by young children, and for infants, bottle removal was encouraged after feeding. At the general population level, salt fluoridation and access to affordable toothbrushes and fluoride toothpaste was encouraged. The integration of traditional

methods of tooth cleaning with fluoride toothpaste was further suggested. It was also recommended that a campaign for promotion of oral health should be delivered through schools, warning of the dangers of smoking tobacco and chewing betel nut, articulating the benefits of fluoride, and encouraging tooth brushing and the use of fluoride toothpaste. It was recommended that a programme for screening and fissure sealing could provide preventive dental care for older children and that personal dental care should be provided as both urgent oral treatment and atraumatic restorative treatment, while routine dental treatment should be integrated with the primary health service (AusAID 2002).

7.3.2 Timor-Leste National Oral Health Strategy 2004

The *National Oral Health Strategy* (TL-NOHS 2004) was released in 2004 by the Ministry of Health (MoH) and largely accepted the oral-health policy recommendations of the National Oral Health Survey (**Error! Reference source not found.**). It recommended salt fluoridation, affordable fluoride toothpaste, a school dental service and integration of oral health into general health promotion, and focused on preschool children, pregnant women and mothers of young children, schoolchildren and people who smoke or chew betel quid.

7.3.3 National Health Sector Strategic Plan 2011-2030

The *National Health Sector Strategic Plan 2011–2030* noted that oral health was a priority within a range of essential health interventions and that the most common problem was dental caries, but that the treatment of the dental problems was "far beyond the capacity of the existing health workforce and the budget of the MoH" (MoH 2011). It recommended ensuring access of the whole population to appropriate oral-health services, reorientation of clinical service delivery from a curative model of care to a blend of promotive, preventive and curative interventions, and promotion of community awareness and participation in priority target groups (Table 7.1). Key indicators were: increased scholarships for oral health professionals, 75% of health centres implementing oral-health programmes, baseline data on periodontal diseases and oral cancer, and at least 35% of schools participating in oral-health promotion and education.

Table 7.1. Existing policy recommendations for improved oral health in Timor-Leste

Recommendations from the 2002 Australia-East Timor National Oral Health Survey	Timor-Leste 2004 National Oral Health Strategy	National Health Sector Strategic Plan 2011-2030
Population oral health integrated with general health promotion Smoking cessation Betel quid chewing Child dental caries: 1: Integrate infant and pre-school child oral health into general health measures 2: Promote non-acidic, non-sugary fluids and removal of bottle after feeding **Specific population oral health promotion** Salt fluoridation Affordable toothbrushes and toothpaste Continuation of traditional tooth cleaning methods, but with fluoridated toothpaste School oral health promotion campaign: 1: Anti-smoking 2: Anti-betel quid chewing 3: Importance of fluoride	1. National oral health protection, promotion and prevention program Salt fluoridation Affordable fluoridated toothpaste School Dental Service 2. Oral health integrated with general health promotion Preschool children Pregnant women and mothers of young children School children People who smoke or chew betel nut 3. Support for service delivery Appropriate and affordable oral health service Improve coverage and quality of oral health services 4. Personal dental care Blend between promotive and curative interventions Strengthening the referral system	**Objective** To improve oral health of the Timorese people by establishing an appropriate and affordable oral health service that is accessible to all. **Strategies** 1. To ensure access to appropriate oral health services to the population at all facility levels 2. To reorient clinical service delivery from a curative model of care to a blend of promotive, preventive and curative interventions 3. To promote community awareness and participation in priority target groups who are at risk of critical oral conditions

Recommendations from the 2002 Australia-East Timor National Oral Health Survey	Timor-Leste 2004 National Oral Health Strategy	National Health Sector Strategic Plan 2011-2030
4: Use of toothbrushes and toothpaste Screening and fissure sealant program **Provision of personal dental treatment** Oral urgent treatment Atraumatic restorative treatment Routine dental care as part of personal dental treatment with a primary health care service	5. Research directions Use of processed and other salt quantities consumed. Oral mucosal changes related to betel quid chewing and smoking 6. Human resource development Multiskilling the workforce 7. Institutional approach Integration of all community services with planning undertaken at the district level. 8. Strategic alliances External assistance Contracting out Private sector 9. Monitoring and evaluation Monthly reports from health facilities to guide district operational planning	

7.3.4 Formulating Oral Health Strategy for South-East Asia 2008

A report from the World Health Organization (WHO) South-East Asia Region recommended that WHO Member States should undertake a situational analysis, reflect oral health in their national health policies, have promotion and prevention plans for oral health, integrate oral health into other health programmes, adopt a multidisciplinary approach, strengthen the oral-health workforce and establish surveillance of oral health and regular monitoring of oral-health programmes (WHO 2009).

7.3.5 World Health Organization framework for oral health 2010

The WHO framework for oral health, *Equity, social determinants and public health programmes*, published in 2010, gave an overview of international policy on oral health (**Error! Reference source not found.**) and examined social determinants, entry points and interventions to address inequalities in oral health (Kwan and Petersen 2010). The framework recommended that policies aiming to influence oral health should take into account the socio-economic context and position, with the associated differential exposure and vulnerability to risk of oral disease, and differential health-care outcomes and consequences (Kwan and Petersen 2010).

Table 7.2. Recommendations from the World Health Organization Oral Health Framework

Socio-economic context and position
Legislate local production of quality, affordable oral health products
Removal of taxes on oral health products
Placing oral health within the primary health care approach
Fair and equitable policies
Development of infrastructure for oral health services and population-based interventions
Differential exposure
Regulation on tobacco
Better labelling
Address excess use of alcohol;
Restrict advertising of unhealthy food
Promote the use of mouthguards and safety helmets
Encourage interventions that adopt a common risk factor approach

Support healthy physical and psychosocial environments
Encourage optimal exposure to fluorides
Promote oral health through 'healthy settings' initiatives and encourage them to be part of a larger network
Differential vulnerability
Greater availability of sugar-free alternatives and medicines
Support interventions and make tools available for breaking poverty and social inequalities
Support measures that promote healthy eating and nutrition and reduce amount of sugars, salt and fats in foods and drinks
Re-orient oral health services to improve access and availability
Promote the availability of quality affordable oral health products, healthy foods and drinks
Regulate sale of harmful or unhealthy products to certain high-risk groups in certain settings
Promote oral health through chronic disease prevention, health promotion and health education
Integrate oral health into community, local, national and international health programs
Work in collaboration across government departments and with local communities, other sectors, agencies and non-government and other organisations to promote oral health
Differential health care outcomes
Target resources that support disadvantaged or high-risk groups
Improve early detection of oral cancer and noma with timely treatment and referrals
Tobacco cessation services in dental practices
Include oral health in training of members of the primary health care team
Differential consequences
Regulate sale of harmful or unhealthy products to certain high-risk groups in certain settings
Encourage healthy diets and moderate consumption of alcohol
Outreach oral health care towards vulnerable and poor population groups
Third-party payment systems reducing inequity in use of oral health service

7.4 The Current Situation

In 2014, a follow-up oral survey of schoolchildren in Dili was done; comparative analysis of the 2002 and 2014 survey data for Dili schoolchildren identified that a marginally lower proportion of children in Dili reported brushing their teeth the previous day than did the Dili children in 2002, and twice as many (20% versus 40%) reported experiencing toothache in the previous 12 months (Babo Soares et al 2016). The experience and severity of dental caries, as measured by the mean number of decayed, missing and filled teeth, were greater in 2014 than in the earlier survey. Conversely, there was a lower prevalence and extent of gingival bleeding and calculus,

and a greater proportion of children reported having seen a dentist in the preceding 12 months in the 2014 survey compared with the one in 2002. This indicated that access to treatment may have improved for children in Dili, but this inference cannot be generalized across Timor-Leste.

In a consultation exercise with stakeholders in oral-health policy in Timor-Leste, all noted that few recommendations from the National Oral Health Survey in 2002 had been introduced (AusAID 2002). Little action had occurred in the area of integration of population oral health within general health promotion. Specific policies not introduced were salt fluoridation, affordable toothbrushes and toothpaste, and continuation of traditional tooth-cleaning methods with fluoridated toothpaste, and, while a school oral-health campaign was initiated, implementation was irregular, owing to funding limitations. Although personal dental treatment did supply urgent oral treatment, it did not provide preventive care, atraumatic restorative treatment, or routine dental care as part of personal dental treatment within a primary health-care service.

The consultation highlighted five common themes on what had hindered implementation of the recommendations. These encompassed: (i) lack of local support for the recommendations, particularly on promotion of oral health; (ii) lack of financial and budgetary provisions for oral health; (iii) lack of focus on services, human resources and dental personnel; (iv) poor focus, design and implementation of policy and planning in oral health; and (v) lack of transport to facilitate health-care workers' access to remote areas. Poverty posed a major challenge, alongside the pressure of competing priorities such as trade policies that are insensitive to public health (tobacco), a lack of information (disease burdens and economic impact), lack of awareness (limited health literacy), lack of advocacy, and a lack of resources (limited availability, affordability and access).

By contrast, several developments have been initiated in Timor-Leste that were not advocated in 2002. These are: (i) the establishment of a dental therapy school in August 2011; (ii) the creation of a Timor-Leste Dental Service in May 2002, though it is small relative to the population of Timor-Leste and largely supplies urgent oral treatment; (iii) the introduction of dental nurses (trained in Indonesia) during the early 1990s, and after independence in May 2002, who can deliver preventive dental care, extractions

and simpler restorations; and (iv) plans to establish a school of dentistry in Dili in 2017. Although not advocated in 2002, these developments align with the strategic priorities for oral health in Timor-Leste, to deliver oral-health promotion and prevention, to deliver personal dental care and to develop human resources for oral health (TL-NOHS 2004).

7.5 Revised Policies Proposed to Improve Oral Health in Timor-Leste

We propose an updated set of oral-health policies and recommendations for consideration by the government of Timor-Leste. Key priorities to improve the oral health of the population of Timor-Leste include promotion of oral health, legislative interventions, education of the oral-health workforce, dental outreach programmes, targeted dental treatment, dental infrastructure programmes and research and evaluation (Table 7.3).

Table 7.3. Proposed Multistage Oral Health Policy Recommendations for Timor-Leste

Stage 1
1.1 Oral Health Promotion
Further develop the curriculum to cover betel nut chewing, smoking, diet, oral hygiene, and regular dental visiting.
Invite parents to the classes
1.2 Legislative Interventions
All imported salt to be fluoridated.
All imported toothpaste to contain fluoride at 1,000 ppm
Ban tobacco and betel nut use in schools
Remove sweet stalls from schools.
1.3 Health Workforce Education
Continue training dental therapists and dental nurses
Establish a dentistry school for 15 students per year
Train midwives, general nurses and health promotion teachers in dental and oral cancer screening, oral health promotion and fluoride applications, fissure sealants
1.4 Outreach program (Servisu Integradu da Saude Comunitaria: SISCA Program)
Oral health screening, oral health promotion and fluoride applications
Existing Community Health Centre portable dental chairs and equipment
Free toothbrushes and toothpaste to give away after screening

1.5 Dental Treatment

Move the treatment philosophy from oral urgent treatment to prevention and atraumatic restorative techniques

1.6 Infrastructure

Improve the dental equipment, instruments and materials in Community Health Centres.

Use existing portable dental chairs and equipment in Community Health Centres for outreach services (SISCA Program)

1.7 Research and evaluation

Redesign the dental service monthly report to obtain better oral health data collection

Stage 2

2.1 Oral Health Promotion

Promote oral health through 'healthy settings' initiatives in schools and health-promoting schools networks

Oral health campaigns included in general health campaigns

Encourage the use of toothbrushes and fluoride toothpaste in adults, but where that is not practical encourage traditional cleaning methods,

Creation of locally-based oral cancer pamphlets for health workers

2.2 Legislative Interventions

Tobacco packet labelling

Affordable toothpastes and toothbrushes by removing or reducing taxes on these products

Tax all imported sugar to replace, or more than replace, any tax lost from removing the tax on toothpastes and toothbrushes

Food and drinks labelling showing the amount of fats, sugars and salt

Ban smoking and betel quid chewing in public buildings

Restrict advertising of alcohol, tobacco and unhealthy food

2.3 Health Workforce Education

Monitor dental workforce numbers and mix to ensure the most appropriate workforce

Creation of a referral pathway for dental treatment for people found to have oral disease.

Train dental clinicians in the importance of mouthguards for contact sports and how to make them for a later campaign to the public

Train smoking cessation brief interventions by oral health professionals to be done later.

All dental workers be taught how to do basic repairs on dental equipment and have such training as part of the undergraduate programs

Some local handy people, such as electricians, should be taught more advanced dental equipment repair

Scholarships for training in public health, oral and maxillofacial surgery, paedodontics, orthodontics, and oral medicine

2.4 Dental Treatment

Move to basic and then more elaborate restorative dentistry

Ensure every Community Health Centre has at least one dentist

Improve collaborations with oral health volunteer groups

2.5 Infrastructure

Have more than one dental room and dental chair per Community Health Centre

Have the same brands of dental equipment, instruments and materials in all dental surgeries, selecting dental equipment which does not often break down, and when it does break down is easy to repair.

2.6 Research and evaluation

Routinely collect, report and share population health and access to care data

Later, ensure research is used to inform planning and service delivery

Regular external to Timor-Leste evaluation of whether the oral health policy recommendations are occurring

Improve access to the internet for all dental clinicians possibly via mobile phones and iPads.

The proposals tackle the inadequate local support, the shortfalls in financial and budgetary provisions for oral health, and the inadequate focus on oral-health services and the lack of transport, by moving towards community-based prevention of oral diseases, with dental care based on a community-based hub-and-spokes model. The use of inexpensive legislative interventions and the move away from the medical model of dental care to a community-based preventive and minimally invasive one, with services often supplied by local health workers, will be more affordable in the developing economy of Timor-Leste, move the support and focus on oral health from central administration to the local communities, and reduce the need for transport. The proposals are also more likely to succeed than previous ones because circumstances have changed. During the time of the previous reports, the 2002 National Oral Health Survey (AusAID 2002) and the *National Oral Health Strategy*, (TL-NOSH 2004) Timor-Leste was going through a time of great change. The country is now better organized, has more resources, and has researchers able to assist in the local development of evidence-based health policies.

7.5.1 Promotion of Oral Health

The first stage in promotion of oral health should start with children, as Timor-Leste has a rapidly growing and young population. The census of 2010 identified that only 42.5% of children attended school (NSD 2011); despite this low attendance, the ready access to children in schools makes them the most suitable first recipients for the promotion of oral health incorporated into general health promotion. At the same time, national efforts are required to improve access to education for those children currently

missing out. Collaboration with education authorities, school administrators and teachers is required to further develop the school curriculum to cover chewing of betel nut, smoking tobacco, diet, oral hygiene (use of toothbrushes and fluoride toothpaste) and regular dental visiting. Parents should be invited to these classes to reinforce the messages at home.

Timor-Leste should progressively develop oral-health campaigns that encourage the use of toothbrushes and fluoride toothpaste in adults (Wright et al 2014), but where that is not practical, they should encourage traditional cleaning methods, e.g. datum, leaves and charcoal. Also needed are locally designed pamphlets on oral cancer for health workers that show early-stage oral cancer, and the creation of a referral pathway for people suspected to have oral cancer.

7.5.2 Legislative Interventions

The first stage in recommended legislative interventions should be to ensure that all salt is fluoridated, (Marthaler et al 2005) and that all toothpaste contains fluoride at 1000 parts per million. (Wright et al 2014). Water fluoridation[15] is not practical in Timor-Leste because the country does not have an extensive or clean reticulated water supply. However, Timor-Leste and the Asian Development Bank have recently announced plans to improve the water supply and sanitation for rural areas (Shute-Trembath 2016). Salt and toothpaste are almost all imported into Timor-Leste and so arranging for them to contain fluoride can be done at little cost. At the same time, banning the use of tobacco (Warnakulasuryia et al 2010; Nagpal et al 2014) and betel nut, (Trivedy et al 2002) as well as sweet stalls in schools, (Burt and Pai 2001) could be implemented by the Department of Education with little difficulty.

At a later stage, the Government of Timor-Leste could investigate affordable toothpastes and toothbrushes, by removing or reducing taxes on these products and putting a tax on imported sugar to replace the revenue thereby lost. It could also label food and drinks, indicating the amount of fat, sugar and salt, ban smoking and betel-quid chewing in public buildings, and restrict the advertising of alcohol, tobacco and unhealthy food.

7.5.3 Education of the Oral Health Workforce

The Government of Timor-Leste should continue to train dental therapists and dental nurses to supply preventive and atraumatic restorative dental care (Frencken et al 2012). Establishing a dentistry school will supply a workforce to attend to complicated treatments. A framework to monitor the numbers and mix of the dental workforce will enable better workforce strategies to support the needs of Timor-Leste.

The Timor-Leste Dental Service should train midwives, general nurses and health-promotion teachers in dental screening, using the "Lift the Lip" screening programme (Rogers 2011) and screening for oral cancer, promotion of oral health, fluoride applications and glass ionomer sealants. It should also create a referral pathway for dental treatment for children with oral disease. Next, the Timor-Leste Dental Services should train dental clinicians in preventive practices such as mouthguards and smoking cessation.

7.5.4 Dental Outreach Programmes

Timor-Leste should focus on strengthening the availability and quality of oral-health services offered at the community health centres, health posts and via the outreach programme, Servisu Integradu da Saude Comunitaria (SISCa) (MoH 2007). SISCa is an outreach programme designed to provide basic primary health-care services to communities and households at 602 posts all over the country.

7.5.5 Targeted Dental Treatment

Dental treatment should move from urgent oral treatment to prevention, with in-surgery oral and general health promotion, (Varenne 2015) fluoride applications, (ASTDD 2007) fissure sealants (Beauchamp et al 2008) and atraumatic restorative techniques, (Rogers 2011) not only by dental practitioners, but by outreach health workers. At a later stage, as determined by Timor-Leste Dental Services, these services could include basic and then more elaborate restorative dentistry. The policy should be that every community health centre has at least one dentist, so that a process can be established whereby outreach health workers can refer people with oral problems to a dentist.

7.5.6 Dental Infrastructure Programmes

Dental equipment, instruments and materials in community health centres need to be improved in a staged process, and the existing community health centre portable dental chairs and equipment should be used for the outreach SISCa programme. There needs to be more than one dental room and dental chair per centre, so that they can act as incoming referral centres from the sucos (villages) and aldeias (sub-villages). The same brands of dental equipment, instruments and materials are required in all dental surgeries. Quality equipment should be selected that does not regularly break down and is easy to maintain and repair.

7.5.7 Research and Evaluation

Currently, the Timor-Leste Department of Health collects basic data on the productivity of dental practitioners, such as the number of patients seen and the treatments provided. For research and evaluation, the first step is to redesign the current monthly reporting systems of the dental service, in order to obtain data on oral health, rather than solely focusing on staff productivity. The *National Health Sector Strategic Plan 2011–2030* proposed an improvement of the communication systems (including radio and internet connections) to provide all health facilities with suitable systems for patient referral and the transfer of management data (MoH 2011). Linking the collection of data on oral health with such a communication system would be ideal.

Later stages should include supporting research that develops and evaluates models of oral health care and access; routinely collecting, reporting and sharing population health and access to care data, to ensure research is used to inform planning and service delivery; conducting regular evaluation external to Timor-Leste, to determine whether recommendations for oral-health policy are being implemented; and improving communications access through wider use of mobile phones and portable computers, so dental clinicians can remain informed of current literature and international practice in oral health care.

7.6 Conclusion

Copying the medical model to improve oral health is not feasible in a developing economy with a rapidly growing population, as found in Timor-Leste. Hence, the approach should be preventive interventions: oral health promotion for school children,

salt fluoridation, fluoride toothpaste and banning sweet stalls and use of tobacco and betel nut in schools. Timor-Leste should focus on strengthening the availability and quality of oral-health services offered outside of the larger cities, and train midwives, general nurses and health-promotion teachers in dental and oral-cancer screening, promotion of oral health, fluoride applications and glass ionomer sealants. Dental therapists and dental nurses who can supply preventive and atraumatic restorative dental care should continue to be trained, and Timor-Leste should continue to work towards establishment of a dentistry school to supply a workforce for more complex treatments. Ongoing research and evaluation is needed to ensure that the approach being used in Timor-Leste is leading to improved outcomes in oral health.

7.7 Postscript

In this chapter, a review the policy and practice relevant to oral health in Timor-Leste from 2002 to the present was reported. An updated set of oral-health policies and recommendations for consideration by the government of Timor-Leste were proposed.

The next chapter provides a comprehensive overview, limitations and strengths of the present study and draws together a discusson on the future direction for oral health in Timor-Leste. It includes a brief discussion of the results of papers in chapters 3, 4, 5 and 6, and reflects on the limitations and strengths of the study. Necessary further oral health research for Timor-Leste is also addressed. Lastly, the main findings described in the four papers in those chapters are given in the conclusion section.

Chapter 8

Overview, Limitations and Strengths, Future Directions, and Conclusions

8.1 Overview

As a new nation, the population of Timor-Leste faces many health problems, and difficulty with accessing services, particularly in the oral health sector. In 2002, the AusAID-sponsored National Oral Health Survey of East Timor found over 85% of children and adults had never made a dental visit, and less than half the adults who reported having made a dental visit did so to a dentist or dental nurse. Some visits were made to general medical practitioners, but nearly half were made to other providers such as traditional healers (AusAID 2002). The overall percentage of tooth decay was found to be moderate to low in both children and adults, the low prevalence of tooth decay was probably linked to a low-sugar subsistence farming diet. The tooth decay was mostly untreated, and if treated it was by extractions, not necessarily performed by dentists or dental nurses (AusAID 2002). Over three quarters of adults reported tooth brushing and over 70% reported using toothpaste (AusAID 2002). Over 70% of male adults were current smokers and most female adults and almost a quarter of male adults chewed betel nut (AusAID 2002).

On the basis of the 2002 survey results, the report delivered a series of policy recommendations to improve oral health in Timor-Leste. These included the integration of oral health promotion with general health promotion, actions to reduce the high prevalence of smoking and betel nut chewing, and monitoring of the oral health of infants and children younger than school age as a component of general health check-ups. Non-acidic and low sugar fluids were to be promoted for consumption by young children, and with infants, bottle removal was encouraged after feeding. At the general population level, salt fluoridation was suggested given the impediments to fluoridation of drinking water in Timor-Leste, and access to affordable toothbrushes and fluoride toothpaste was encouraged. The integration of traditional tooth cleaning methods and fluoride toothpaste was further suggested. An oral health promotion campaign was

suggested for delivery through schools, to warn of the dangers of smoking and chewing betel nut, to articulate the benefits of fluoride, and to encourage tooth brushing and the use of toothpaste. A screening and fissure sealant programme was encouraged to provide preventative dental care for older children. The authors recommended that personal dental care should be provided as both oral urgent treatment and atraumatic restorative treatment, and routine dental treatment should be integrated within the primary health service.

In 2014 I conducted, interviews with health policy makers, dental professionals and health academics in the district of Dili, Timor-Leste, to find out whether the recommendations of 2002 National Oral Health Survey were implemented. The majority of the people interviewed stated that the recommendations of the report were important, but most of the recommendations were not implemented. The respondents mentioned human resource and funding issues as the two most important impediments to the recommendations being implemented. Respondents also identified inappropriate guidelines, poor planning of dental programs, and limited population coverage of services, poor management, and lack of infrastructure as factors impeding the implementation of the recommendations. The interviews showed that four policies had progressed, not all of which were recommendations from the National Oral Health Survey. These policies were: 1) The establishment of a dental therapy school; 2) The creation of a Timor-Leste Dental Service, though it is small in size compared to the needs of the growing Timor-Leste population, and largely supplies oral urgent treatment; 3) Dental nurses, trained in Indonesia, who can provide dental extractions and simple restorations,; 4) Plans to establish a dentistry school in Dili.

My 2014 survey of the oral health of school children in Dili found permanent teeth dental caries experience and dental caries prevalence increased from the 2002 study. The increase in the dental caries experience and prevalence may be attributed to an increase in sugar consumption. There is no data on individual sugar consumption in Timor-Leste. However, almost all sugar consumed in Timor-Leste is imported. Thus, sugar importation data from 2003 to 2014 is a proxy measure for increased sugar consumption across the population. The period between 2002 and 2014 also saw increasing imports of westernised food. This suggests that the diet of children living in Dili has shifted away from thetraditional low-sugar foods, such as corn, cassava, potato

and vegetables, towards an increasingly westernised diet with high levels of sugar consumption.

The decreased prevalence and extent of gingival bleeding and calculus in my 2014 research suggests an improvement in oral hygiene from 2002. The increased dental caries experience and prevalence may explain why toothache in the previous 12 months, avoiding eating certain foods due to toothache, and being unhappy about the appearance of their teeth, was higher among children in 2014 compared to 2002.

The fact that a greater proportion of children reported seeing a dentist in the previous 12 months and the greater mean number of filled teeth, indicated that the Timor-Leste Dental Service was able to supply more restorative dental care in 2014 than 2002. However, the greater active dental caries prevalence, the continued high proportion of dental visits for a problem (rather than preventative care), and the higher proportion of children with toothache in 2014 compared to 2002, indicated that the dental service was unable to supply the volume of dental restorative care required for the population. The higher prevalence of missing teeth in 2002 than 2014 may be explained by dental professionals from the UN Peacekeeping Force (Whittington 2014) visiting schools in 2002 and extracting teeth rather than restoring them. This treatment philosophy was appropriate in 2002 as the UN Peacekeeping Force dental practitioners were going to be in Dili for only a short time, and did not want to leave dental problems behind when they knew there was little local dental care available.

My research also investigated dental caries experience (dmft+DMFT) between children in low SES schools and mid-high SES schools. The results of the analysis demonstrated that primary dental caries experience was higher in the children from mid-high SES schools than children from low SES schools. This result was different to that found in previous studies (Schwendicke et al 2015). However, there was more toothache, more visits to the dentists in the past 12 months, and more calculus in the children from low than mid-high SES schools. This seemingly contradictory result may be explained by low SES school children, though visiting a dentist more often and low SES schools being targeted by the Timor-Leste Dental Service, were likely to visit for a problem, while mid-high SES school children may be more likely to visit for a check-up.

My research also investigated the association between parental education level and the prevalence of untreated decaying teeth. The prevalence of untreated carious primary teeth was greater in the children of Dili who had parents with lower compared to children of parents with higher education levels. This is similar to what has been found in other studies in both developed and developing economies (Pitts et al 2011; Do 2012; Schwendicke et al. 2015). This is an important result because it allows policy makers and researchers investigate why this is so, and to make policies that will reduce the prevalence of untreated tooth decay in children of parents with lower education levels.

The information from the interviews, relevant policy documents and the survey was used to develop an appropriate and readily implementable set of policy recommendations for the country. The majority of the recommendations from the National Oral Health Survey of East Timor Project 2002 were not introduced, but four policies not recommended were introduced. This suggested that the local people wanted to control their own policy development. Hence, this thesis has made a set of oral health policy recommendations for the consideration of the Timor-Leste Government.

From my research I have identified seven key priorities needed to improve the oral health of the population of Timor-Leste. I have argued that replicating the medical model of other countries in an attempt to improve oral health in Timor-Leste was not practicable as the country is experiencing a rapidly growing population and has limited resources. Consequently, the approach to improve oral health status in the country should be oriented on preventive interventions: oral health promotion for school children, salt fluoridation, fluoride toothpaste, banning the sale of sugary drinks and confectionary in schools and banning the use of tobacco and betel nut in schools. The core oral health programs in Timor-Leste should be oriented toward strengthening the availability and quality of oral health services offered in districts and sub-districts of the country, and delivering preventative dental training for midwives, general nurses and health-promotion teachers. This dental training should include oral cancer screening, promotion of oral health, and the application of sodium fluoride, silver diamine fluoride and glass ionomer sealants, which halt the progress of decay in children's teeth so that simple dental treatments can be provided in remote areas, many of which have only basic facilities. Training of the existing dental workforce, dental nurses and therapists, who can supply preventive and atraumatic restorative dental care

should continue. However, there remains a need to establish a dentistry school to supply a workforce for more complicated dental treatments. Further research and evaluation is needed to guarantee that the oral health programs being implemented in Timor-Leste are leading to enhanced outcomes in dental health.

8.2 Study Limitations and Strengths

The 2014 survey was cross-sectional in nature and the study was limited to school children in four subdistricts in the Dili district. The previous study was a national cross-sectional survey of both children and adults, and involved a large number of participants from 12 subdistricts across the country, including Dili. Hence, the children who participated in the 2002 survey were different children to those who particated in the 2014 nsurvey, despite only including children recuited in Dili in the 2002 survey for the comparative analyses. Cross-sectional surveys give information at a specific point in time. Thus we could not determine cause and effect.

The limitations related with a questionnaire can also be considered a weakness of the study. It is possible that data collected from questionnaires completed by parents, carers or children aged 15-17 years, may have been subjected to recall bias, especially in relation to information relevant to oral health behaviours over the past 12 months.

There are 32 dialects in Timor-Leste and the study was completed in Tetum (Timor-Leste's official language). The survey did not include the local dialects of Timor-Leste and may have missed some demographic groupings, thereby reducing the demographic diversity. There may have been an inability to understand the questions, and some respondents may have given answeres they thought was most acceptable to the clinical examiners. However, a strength of the study was the recruitment of children who matched the age and sex distribution of the wider population of children living in Dili aged 6-17 years.

The inability to recruit children who did not attend school is a limitation of the study. This is due to low rates of school attendance in Dili and wider Timor Leste. Community-based recruitment of school age children not attending school was beyond the resource capacity of this research. The 2010 Census demonstrated that overall school attendance for the district of Dili was 42.5%, with the majority of the non-attending school children living in the rural areas of Dili. It may be that the children not attending school had

different diets, oral hygiene habits, dental visiting behaviours and dental caries experience than children who did attend school.

Another limitation was that individual sugar consumption data for participating children was not collected, making it impossible to investigate the associations between sugar consumption level, socio-economic status, the prevalence of decay and mean dmft/DMFT. As individual sugar consumption data was not collected in the 2002 survey, it was not possible to investigate sugar consumption levels among children in 2002 versus 2014. Instead, we had to interpret our findings with reference to sugar importation and population data for Timor-Leste. Although this proxy measure of individual sugar consumption is limited, it does provide an indication of change in per capita sugar consumption.

This study used the Decayed, Missing and Filled deciduous and permanent Teeth (dmft+DMFT) Index as a measure of caries dental experience and prevalence. Although the index can provide convincing data and assessments on tooth decay, it has some weaknesses. One criticism of the index is that the values do not provide any indication of the number of teeth at risk. Other criticisms of the index is that it does not provide useful data for estimating treatment needs; that it gives equal weight to missing, untreated decayed, or well restored teeth; that it does not account for teeth lost for reasons other than decay (such as periodontal disease); and that it does not account for teeth with sealants or cosmetic restorations (Broadbent et al 2005; Burt 1997). However, as dental treatment in Dili is largely problem-based, the issues of sealants and cosmetic restorations was not particularly relevant to this study.

Previous research has noted a significant amount of inter-observer bias and variability from the use of the dmft+DMT index for research purposes (LeSaffre et al 2004). However, in our study, inter-rater reliability was high. This was achieved through extensive oral examination training and calibration exercises delivered to the examiners dentists and dental nurses prior to data collection

This is the first study in over a decade to report on the oral health status of children in Dili. Our research also explored the oral health policy environment of Timor Leste, and provides an update on oral health policy recommendations for consideration by the Timor-Leste Government. Our research is the first study to investigate dental caries

experience and active carious teeth in children from low compared to mid-high SES schools in Timor Leste. The results provide a new perspective on the relationship between socio-economic status and dental caries experience among children in a developing country. A perspective that contrasts with the findings of previous research.

A randomised sample approach was employed similar to the method used in 2002 survey, which ensured equal numbers of participants in each of the four age groups. Our research recruited a more than adequate number of participants to achieve sufficient power to test the hypotheses of the study. The study recruited 40 schools, which was 37% of all schools in Dili. The 2002 study randomly selected two subdistricts in the Dili district and 201 children to participate in the survey. However, the 2014 study randomly selected four subdistricts in Dili with 758 participants. A larger sample size in the current survey provided an appropriate sample size for testing the association between oral health variables and dental caries experience and prevalence.

Multi-variable analysis, which considers the simultaneous effect of several variables, was used in the data analysis. This method was used to test the relationship between the caries prevalence and experience with variables such as SES outcomes, parental education level, and oral hygiene status, unhappy about the appearance of their teeth, toothache, dental visits, and reason for dental visit, treatment received at last dental visit, gingival bleeding and dental calculus. The analysis method allowed us to investigate the associations between prevalence of decayed teeth (and the dental caries experience) and putative confounder variables.

8.3 Future Directions in Timor-Leste Oral Health Research

Further oral health research needs to be undertaken in Timor-Leste to evaluate whether the recommendations proposed in this thesis are implemented and to evaluate oral health policies that have been implemented in the past. Examples of programs that should be evaluated include oral health promotion targeted at particular demographic groups, supplying affordable toothbrushes and toothpaste, school-based dental health education and screening, and fluoride and fissure sealant programs.

Efforts in the coming years should be directed toward questions that have not been addressed in the previous and the present study. This should include vitally important

research into the oral health of children who do not attend school and the oral health of children living in rural areas. Research should also be focussed on evaluation of prevention strategies suitable for Timor-Leste (e.g. silver fluoride) and the integration of dental treatments within community health worker activities. Additionally, updated information research is needed on the oral health of adults inside and outside city areas and research should also explore the association of individual socio-economic status (as opposed to school) with oral health among both adults and children. Reseaarch into household use of salt and quantities consumed would be an important foundation prior to the consideration of salt fluoridation. Also, data on betel quid chewing and smoking prevalence, especially among children, is essential to inform public health policies. A second national oral health survey of children and adults would help to establish long-term trends in oral health, with the results of the last national oral health survey offering baseline data to benchmark subsequent surveys. This research is important to provide an evidence base for local oral health policies designed to improve the oral health status of the Timor-Leste people.

8.4 Conclusions

There was a greater dental caries experience in Dili school children in 2014 compared to 2002, associated with a greater permanent teeth dental caries experience.

The dental caries experience in 2014 was greater among children from mid-high rather than from low socioeconomic schools, a fact which may be explained by high sugar consumption.

The prevalence of untreated carious teeth was greater in the children of Dili who had parents with lower than higher education levels.

Copying the medical model to improve oral health is not feasible in a developing economy with a rapidly growing population, as found in Timor-Leste. Hence, the approach should be preventive interventions: oral health promotion for school children, salt fluoridation, fluoride toothpaste and banning sweet stalls and use of tobacco and betel nut in schools. Timor-Leste should focus on strengthening the availability and quality of oral-health services offered outside of the larger cities, and train midwives, general nurses and health-promotion teachers in dental and oral-cancer screening, promotion of oral health, fluoride applications and glass ionomer sealants. Dental

therapists and dental nurses who can supply preventive and atraumatic restorative dental care should continue to be trained, and Timor-Leste should continue to work towards establishment of a dental school to supply a workforce for more complex treatments. Ongoing research and evaluation is needed to ensure that the approach being used in Timor-Leste is leading to improved outcomes in oral health.

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Appendices

Appendix 1: Tables

Appendix 1A: Age-Related Caries Experience in Primary Dentition

Study, Authors and years of study	Location	Type of study	Number of subjects	Age	Caries Free (%)	Caries (%) in Primary dentition	d	m	t	dmft	sd	dmfs	sd
Chidambaram Taluk Study, by Saravanan et al,2008	Tamil Nadu, India	Cross Sectional Study (WHO criteria, 1997)	T : 508	5-10	71 %	29 %	--	--	--	3.00	3.03	--	--
			--	5-6	70.2%	29.8%	--	--	--	3.54	3.71	--	--
			--	--		--	--	--	--	--	--	--	--
			M; 247										
			F : 261										
Chandīgarh Study, by Goyal et al, 2007	Chandīgarh, India	Random Sample (Moller's Index, 1966)	T :1816	--	--	--	--	--	--	--	--	--	--
			--	6	20.26%	79.74 %	--	--	--	4.00	3.68	8.98	11.05
			--	9	7.89%	92.11 %	9.5	--	--	4.61	3.14	9.88	8.46
Brazilian Dental Caries Survey, by Fernandes et al, 2009.	Alagoinha, Brazil	Random Sample Strategy (WHO Criteria)	T : 127	4 – 6	21.3%	78.7 %	4.18	0.34	0.11	4.45	3.9	--	--
			Male: 73	--	21.9%	78.1 %	4.0	0.34	0.05	4.3	3.8	--	--
			Female : 54	--	24.4%	79.6 %	4.43	0.33	0.19	4.65	4.0	--	--

Study, Authors and years of study	Location	Type of study	Number of subjects	Age	Caries Free (%)	Caries (%) in Primary dentition	d	m	t	dmft	sd	dmfs	sd
Undaipur, Rajasthan Dental Caries Survey, by Dhar et al, 2009.	Undaipur, Rajasthan, India	Random Sample (WHO criteria 1999)	T : 750	6 – 10	36.8%	63,20 %	69.94%	14.70%	15.36%	2.60	2.05	--	--
			--	6 – 7	48.47%	51.53%	--	--	--	--	--	--	--
			--	8 – 10	33.56%	66.44	--	--	--	--	--	--	--
			Male : 396	--	33.09%	66.91 %	--	--	--	2.82	2.01	--	--
			Female : 354	--	40.97%	59.03 %	--	--	--	2.37	2.09	--	--
Jamaica study, By Lueckel et al, 2002.	St. Elizabeth – Jamaica.	Cross-Sectional Study.	T : 1558	6 - 16	--	--	--	--	--	--	--	--	--
				6	28.3%	71.7%	96.9%	1.8	1.3	3.2	3.5	7.9	10.7
				9	--	--	--	--	--	--	--	--	--
				12	--	--	--	--	--	--	--	--	--
				15	--	--	--	--	--	--	--	--	--
The Hague dental survey, by Truin et al, 2004.	The Hague, the Netherlands	Random Sample strategy	T: 832	6 -12	--	--	--	--	--	--	--		
				6:	--	--	--	--	--	--	--		
				SES High	79%	--	--	--	--	0.7	1.8		
				SES Med.	68%	--	--	--	--	1.1	2.4		
				SES Low	48 %	--	--	--	--	4.1	6.7		
Accra Study, by Bruce et al, 2002	Accra, Ghana	Cross-Sectional Survey	1851	4-16	69%	31%	--	--	--	--	--		
				4-5	68%	32%	--	--	--	0.94	0.14		
				6	64%	36%	--	--	--	0.97	0.16		
				7-9	55%	45%	--	--	--	1.11	0.07		

Study, Authors and years of study	Location	Type of study	Number of subjects	Age	Caries Free (%)	Caries (%) in Primary dentition	d	m	t	dmft	sd	dmfs	sd
Sana'a Study, by Al-Haddad et al, 2010.	Sana'a City, Yemen	Random Sample Strategy (WHO criteria)	Total: 1489	6-14	4.1%	--	--	--	--	4.16	--	8.45	--
				6-8	5.5%	--	6.37	0.23	0.08	6.68	3.80	13.12	9.18
				9-11	3.0%	--	3.32	0.24	0.05	3.62	2.56	7.68	6.93
				12-14	3.7%	--	1.05	0.07	0.01	1.13	1.48	2.49	3.72
			Female: 767	--	2.1%	--	--	--	--	4.28	3.67	8.48	8.03
			Male : 722	--	6.2%	--	--	--	--	4.04	3.61	8.43	8.74
Nepal's Survey, by Yee et al, 2002	Central and Western of Nepal	Non-randomized cross-sectional survey (WHO Pathfinder Methodology)	Total: 5410	--	--	--	--	--	--	--	--		
			--	5-6	--	67%	3.2	0.1	0	3.3	0.1		
			--	12-13	--	--	--	--	--	--	--		
			Male	--	--	70%	3.6	0.1	0	3.7	0.12		
			Female	--	--	63%	2.8	0.1	0	2.9	0.10		
			Both	--	--	67%	3.2	0.1	0	3.3	0.07		
Riyadh study, by Al-Banyan et al, 2000	Riyadh, Saudi Arabia	Cross-sectional study (Dean criteria)	Total : 272	5-12	--	90%	--	--	--	3.8	3.2	21.5	15.7
				5	--	--	--	--	--	4.5	3.8	30.4	20.2
				7	--	--	--	--	--	4.2	4.0	30.1	14.6
			Male:: 154	--	--	--	--	--	--	--	--	--	--
			Female: 118	--	--	--	--	--	--	--	--	--	--
China's survey, by Wong et al, 2001	Southern China.	Combination of multi-stage stratified sampling and quota sampling	Total: 3163	5-12	--	84%	--	--	--	6.5	0.3		
			Male in Urban	5-6	--	78%	4.8	<0.1	0.1	5.0	0.2		
			Female in Urban	5-6	--	79%	4.5	<0.1	0.1	4.7	0.2		
			Both	5-6	--	78%	4.7	<0.1	0.1	4.8	0.2		
			Male in Rural	5-6	--	90%	7.7	<0.1	<0.1	7.7	0.3		

Study, Authors and years of study	Location	Type of study	Number of subjects	Age	Caries Free (%)	Caries (%) in Primary dentition	d	m	t	dmft	sd	dmfs	sd
			Female in Rural	5-6	--	82%	6.3	<0.1	<0.1	6.4	0.3		
			Both	5-6	--	86%	7.0	<0.1	<0.1	7.0	0.3		
Iran National Survey, by Movahed et al, 2011	Iran	A cluster multi-stage probability sampling (WHO Standard Methodology)	Total: 18.946	3-12	--	-	--	--	--	--	--		
			Male & Female	3	42%	-	1.8	0.05	0.03	1.9	0.2		
			Male & Female	6	11%	--	4.4	0.4	0.2	5.0	0.0		
			Male % Female	9	10%	--	2.9	0.6	0.2	3.6	0.0		
			Male & Female	12	32%	--	--	--	--	--	--		
Praiba's study, by Paredes et al, 2009	Paraiba, Brazil	Cross-sectional and quantitative study. (WHO criteria)	T: 410	3-13	--	--	--	--	--	--	--		
			--	3-5	13.9%	13.2%	--	--	--	2.38	3.27		
			--	6-9	11.2%	29.0%	--	--	--	2.97	3.12		
			--	10-13	7.60%	25.1%	--	--	--	0.89	1.73		
			Male: 204	--	15.1%	34.6%	--	--	--	--	--		
			Female: 206	--	17.6%	32.7%	--	--	--	--	--		
Dehli's study, by Grewal et al, 2011.	Urban Dehli, India	Cross-sectional study(WHO criteria)	Total: 520	9-12	--	52.30%	0.48	0.01	0.00	0.50	1.08		
			--	9	--	61.11%	2.16	0	0	2.16	2.20		
			--	10	--	63.75%	0.88	0	0	0.90	1.42		
			--	11	--	69.82%	0.57	0	0	0.59	1.08		
			--	12	--	36.36%	0.24	0	0	0.27	0.61		
			Male	--	--	50.45%	--	--	--	--	--		
			Female	--	--	55.61%	--	--	--	--	--		
			Both	--	--	52.30%	--	--	--	0.50	1.08		

Study, Authors and years of study	Location	Type of study	Number of subjects	Age	Caries Free (%)	Caries (%) in Primary dentition	d	m	t	dmft	sd	dmfs	sd
OHSAR survey, by Perinetti et al, 2005	Abruzzo Region, Italy	Random sample strategy (WHO criteria,1997)	Total: 5938	7-11	--	57.9%	--	--	--	--	--	--	--
				7	--	--	1.56	--	0.19	1.75	2.66	3.13	5.36
				9	--	--	1.69	--	0.42	2.11	2.42	3.86	5.09
				11	--	--	--	--	--	--	--	--	--
National Oral Health Survey, by AusAID 2002.	Democratic Republic of Timor-Leste (East Timor)	Stratified random sample strategy (WHO guidelines)	T: 1042	6-11	--	57.9%	2.2	0.1	0.0	2.3	--		
			Male: 543	6	--	--	3.73	0.05	0.00	3.78	--		
			Female: 487	6-8	--	72.6%	3.3	0.1	0.0	3.4	--		
				9-11	--	46.9%	1.4	0.1	0.0	1.5	--		
				--	--	55.6%	2.3	0.1	0.0	2.4	--		
				--	--	60.9%	2.2	0.1	0.0	2.3	--		

Appendix 1B: Age-Related Caries Experience in Permanent Dentition

Study, Authors And Years Of Study	Location	Type of study (Methodology)	Number of subjects and Gender	Age	Caries Free (%)	Prevalence of dental caries (%)	D	M	F	DMFT	SD	DMFS	SD
Chidambarm Taluk Study by	Tamil Nadu, India	Cross Sectional Study (WHO criteria, 1997)	T: 508	9-10	73.5%	26.5%	--	--	--	0.42	0.84	--	--
Saravanan et al,2008			Male: 247	--	--	--	--	--	--	0.50	--	--	--
			Female:261	--	--	--	--	--	--	0.35	--	--	--
Chandīgarh Study, by Goyal et al, 2007	Chandīgarh, India	Random Sampel (Moller's Index, 1966)	T: 1816	12	--	80%	3.96	--	--	3.03	2.52	4.06	3.91
				15	--	87%	3.96	--	--	3.82	2.85	5.12	5.12
Khartoum, School Base Survey, by Nurelhuda et al, 2009.	Khartoum State, the Sudan	Stratified Rand. Sample Strategy. (WHO Criteria 1997)	T: 1109	12	--	--	0.38	0.03	0.014	0.42	0.1	--	--
			M:553										
			F: 556										
New Zealand Study, by: Page et al, 2012l	Taranaki, New Zealand	Random Sample/Follow up,(WHO guidelines for survey 1997)	T: 430	13-16	--	--	--	--	--	--	--	--	--
			Male	13	--	67.8%	--	--	--	--	--	2.7	5.3
			Male	16	--	84.3%	--	--	--	--	--	3.9	5.7
			Female	13	--	68.3%	--	--	--	--	--	3.0	4.1
			Female	16	--	74.2%	--	--	--	--	--	3.3	3.6
			Both	13	--	68.0%	--	--	--	--	--	2.9	4.7
				16	--	79.2%	--	--	--	--	--	3.6	4.7

Study, Authors And Years Of Study	Location	Type of study (Methodology)	Number of subjects and Gender	Age	Caries Free (%)	Prevalence of dental caries (%)	D	M	F	DMFT	SD	DMFS	SD
Jamaica study, by Mayaer-Lueckel et el, 2002.	St. Elizabeth – Jamaica.	Cross-Sectional Study.	T: 1558	6-16	--	--	--	--	--	--	--	--	--
				9	--	--	--	--	--	0.9	2.0	1.4	3.1
				12	31.2%	--	90.0%	8.6%	1.4%	2.2	2.1	4.1	4.9
				15	17%	--	74.0%	13.3%	12.7%	3.8	3.3	8.2	8.1
Pelotas study by: Peres MA et al, 2009.	Pelotas, Brazil	Cross-Sectional Study, (WHO criteria, 1997)	T:593	6&12y.o	--	--	---	--	--	0	0	--	--
				12	48.2%	--	0.9	--	--	1.2	1.6	--	--
Uganda ' Baseline Survey, by Wandera et al, 2003	Uganda	Cross-Sectional Study	T: 685	5-22	66.6%	33.4%	26.3%	--	--	0.7	1.4		
			--	10-14	--	--	26.1%	--	--	0.7	--		
			--	15+	--	--	39.8%	--	--	1.2	--		
			Male: 342		--	--	--	--	--	--	--		
			Female: 343		--	--	--	--	--	--	--		
The Hague dental survey, by Truin et al, 2004.	The Hague, the Netherlands	Random Sample strategy	T: 832	6 & 12	--	--	--	--	--	--	--	--	--
				12	88%	--	--	--	--	--	--	0.6	2.5
Bikaners, An Observational study, by Nag et al, 2012	Bikaner-Rajasthan, India	Random Sample Strategy	T: 1000	6-18	--	T: 37.2%	--	--	--	--	--		
			--	6-10	--	11.83%	92.85%	7.14%	0 %	0.16	--		
			--	11-14	--	30.01%	87.39%	4.29%	8.30%	0.68	--		
			--	15-18	--	62.26%	92.53%	1.04%	6.42%	1.81	--		
			Male: 625	--	--	29.92%	93.15	1.98%	4.85%	0.72	--		
			Female : 375	--	--	49.33	88.4%	2.80%	8.8%	1.33	--		

Study, Authors And Years Of Study	Location	Type of study (Methodology)	Number of subjects and Gender	Age	Caries Free (%)	Prevalence of dental caries (%)	D	M	F	DMFT	SD	DMFS	SD
Brazil study, by Leila Grando et al, 2008	Brazil	Two Phase Longitudinal Study. (WHO Criteria)	T: 247	15-17	--	--	0	0	1	2	3.05		
			Male: 116	--	--	46.15	--	--	--	2.0	3.44		
			Female: 131	--	--	46.55	--	--	--	2.0	2.54		
Accra Study, by Bruce et al, 2002	Accra, Ghana	Cross-sectional survey (WHO criteria, 1997)	T:1851	4-16	69%	--	--	--	--	0.79	0.04		
			--	10-11	74%	--	--	--	--	0.57	0.07		
			--	12	77.6%	--	--	--	--	0.39	0.09		
			--	13-16	84%	--	--	--	--	0.30	0.06		
Sana'a study, by Al-Haddad et al, 2010	Sana'a City, Yemen	Random Sample Strategy (WHO criteria)	Total: 1489	6-14	4.1%	--	--	--	--	2.25	--	3.59	--
			--	6-8	5.5%	--	1.15	0.01	0.02	1.17	1.52	1.63	2.50
			--	9-11	3.0%	--	2.19	0.08	0.03	2.30	1.63	3.59	3.44
			--	12-14	3.7%	--	2.90	0.14	0.18	3.22	1.92	5.43	4.15
			Female: 767	--	2.1%	--	2.45	0.07	0.08	2.61	1.87	4.16	3.92
			Male : 722	--	6.2%	--	1.72	0.08	0.07	1.88	1.85	2.99	3.53
Greek study, by Oulis et al, 2011	Aegean and Ionian islands, Greek	Stratified cluster sample strategy (WHO criteria)	T:2481	12 & 15	--	--	--	--	--	--	--	--	--
			--	12	37.1	--	--	--	--	2.05	2.50	3.58	5.64
			--	15	28.9	--	--	--	--	3.19	3.45	5.36	6.96
Nepal study, by Yee and MacDonald 2002	Central and Western of Nepal	Non-randomized cross-sectional survey	Total: 5410	--	--	--	--	--	--	--	0.1		
			--	--	--	--	--	--	--	--	--		
			--	12-13	--	41%	1.1	0	0	1.1	0.03		
			Male	--	--	38%	1.0	0	0	1.0	0.04		

Study, Authors And Years Of Study	Location	Type of study (Methodology)	Number of subjects and Gender	Age	Caries Free (%)	Prevalence of dental caries (%)	D	M	F	DMFT	SD	DMFS	SD
			Female	--	--	43%	1.2	0	0	1.2	0.05		
			Both	--	--	41%	1.1	0	0	1.1	0.03		
Darwin study, by Jemieson et al, 2010.	Darwin Australia	Cohort study	T: 290	6-8	--	17.2%	0.3	0.0	0.0	0.3	0.1 - 0.5		
			(Only ABC study)	11-13	--	44.1%	0.8	0.0	0.2	1.0	0.8 – 1.2		
Brazil study, by Cypriano et al, 2008	Southeastern Brazil	Stratified random sample strategy (WHO criteria, 1997)	T: 2378	12 :	25.7	--	--	--	--	3.02	--		
			--	Low group	32.4%	--	--	--	--	0	--		
			--	Moderate grp	21.8%	--	--	--	--	2.7 – 4.0	--		
			Male: 1135	--	--	--	--	--	--	--	--		
			Female: 1243	--	--	--	--	--	--	--	--		
Riyadh study, by Al-Banyan et al, 2000	Riyadh, Saudi Arabia	Cross-sectional study	T: 272	5-12	--	90%	--	--	--	2.0	1.9	3.1	3.7
			--	10	--	--	--	--	--	3.4	2.0	5.8	3.5
			--	12	--	--	--	--	--	6.0	2.8	13.3	5.9
			Male: 154	--	--	--	--	--	--	--	--	--	--
			Female: 118	--	--	--	--	--	--	--	--	--	--
Nairobi and Mathira study, by Gathecha et al, 2012	Nairobi West and Mathira West, Kenya	Cross-sectional study (WHO criteria, 1987)	T: 639	12:	--	--	--	--	--	--	--		
				Nairobi West									
				Mathira West	--	37.5%	0.67	0.05	0.02	0.76	1.2		
					--	24.0%	0.35	0.01	0.0	0.36	0.7		

Study, Authors And Years Of Study	Location	Type of study (Methodology)	Number of subjects and Gender	Age	Caries Free (%)	Prevalence of dental caries (%)	D	M	F	DMFT	SD	DMFS	SD
China's survey, by Wong, et al, 2001	Southern China.	Combination of multi-stage stratified sampling and quota sampling	Total: 3163	5-12	--	84%	--	--	--	6.5	0.3		
			Male in Urban	12	--	41%	0.7	<0.1	0.1	0.8	0.06		
			Female in Uban	12	--	41%	0.7	<0.1	0.2	0.9	0.08		
			Both	12	--	41%	0.7	<0.1	0.1	0.9	0.05		
			Male in Rural	12	--	36%	0.8	<0.1	<0.1	0.8	0.07		
			Female in Rural	12	--	48%	1.0	<0.1	<0.1	1.1	0.08		
				12	--	42%	0.9	<0.1	<0.1	0.9	0.09		
Qazvin study by Hammisi et al, 2008	Qazvin, Iran	Random sample strategy	T: 780	15 & 16	24.5%	--	2.23	.23	.25	2.71	0.86		
			--	15	25%	--	2.18	.24	.24	2.66	0.85		
			--	16	24%	--	2.28	.22	.26	2.76	0.92		
			Male: 315	--	23%	--	2.42	.24	.22	2.88	0.61		
			Female: 465	--	26%	--	2.04	.22	.28	2.54	0.71		
National Pathfinder Survey, by Movahed et al, 2011	Iran	Pathfinder National Survey method (WHO recommendation)	T: 18946	3-12	--	--	--	--	--	--	--		
			Male: 10114	6	11%	--	--	--	--	0.2	0.0		
			Female: 8832	9	10%	--	0.9	0.02	0.05	0.9	0.0		
				12	32%	--	1.6	0.1	0.2	1.9	0.2		
				--	--	--	--	--	--	--	--		
				--	--	--	--	--	--	--	--		
Uganda study, by Rwenyonyi et al, 2001	Kasese & Kisoro districts, Uganda.	Cross-sectional (WHO criteria)	T: 481	10-14	--	15.8%	2.0	0.0	0.0	0.34	0.92		

Study, Authors And Years Of Study	Location	Type of study (Methodology)	Number of subjects and Gender	Age	Caries Free (%)	Prevalence of dental caries (%)	D	M	F	DMFT	SD	DMFS	SD
Kaunas study, by Machiulskiene et al, 1998.	Kaunas, Lithuania	Random sample strategy (WHO Criteria)	T: 889	12	--	--	--	--	--	7.9	4.1	15.8	9.5
			Male: 439	--	--	--	--	--	--	--	--	--	--
			Female: 450	--	--	--	--	--	--	--	--	--	--
National Oral Health Survey, by Hong-Ying et al, 2002	China	Cross-sectional study (WHO methodology)	T: 140,712	5 - 74	--	--	--	--	--	--	--		
			Male	12	--	40.6%	0.8	--	0.1	0.9	1.4		
			Female	12	--	51.0%	1.1	0.01	0.1	1.2	1.6		
			Both	12	--	45.8%	1.9	0.01	0.1	1.0	1.5		
			Male	15	--	47.7%	1.0	0.2	0.2	1.2	1.8		
			Female	15		57.1%	1.3	0.2	0.3	1.6	2.0		
			Both	15		52.4%	1.2	0.2	0.2	1.4	1.9		
Paraiba study, by Paredes et al, 2009	Paraiba, Brazil	Cross-sectional study (WHO criteria)	T: 410	3-13	--	--	--	--	--	--	--		
			--	3-5	13.9 %	13.2 %	--	--	--	0.02	1.49		
			--	6-9	11.2 %	29.0 %	--	--	--	0.72	1.26		
			--	10-13	7.60 %	25.1 %	--	--	--	2.65	3.00		
			Male	--	15.1 %	34.6 %	--	--	--	--	--		
			Female	--	17.6 %	3	--	--	--	--	--		
Delhi study, by Grewal et al, 2001	Urban Delhi, India	Cross-sectional study (WHO criteria, 1997)	T: 520	9-12	--	52.30%	0.80	0.01	0	0.82	1.34		
			--	9	--	61.11%	1.11	0.00	0	1.11	1.90		
			--	10	--	63.75%	0.60	0.01	0	0.61	1.28		
			--	11	--	69.82%	0.92	0.04	0	0.97	1.40		
			--	12	--	36.36%	0.72	0.01	0	0.73	1.16		
			Male	--	--	50.45%	--	--	--	--	--		
			Female	--	--	55.61%	--	--	--	--	--		

Study, Authors And Years Of Study	Location	Type of study (Methodology)	Number of subjects and Gender	Age	Caries Free (%)	Prevalence of dental caries (%)	D	M	F	DMFT	SD	DMFS	SD
			Both	--	--	52.30%	--	--	--	--	--		
Italian OHSAR Survey, by Perinetti et al, 2005	Abruzzo, Italy	Random sample strategy (WHO criteria,1997)	Total: 5938	7-11	--	--	--	--	--	--	--	--	--
				7	--	--	0.12	0.00	0.03	0.15	0.52	0.21	0.82
				9	--	--	0.35	0.00	0.23	0.59	1.15	0.80	1.75
				11	--	--	0.67	0.01	0.51	1.19	1.63	1.56	2.46
East Timor National Oral Health Survey by AusAID 2002.	Democratic Republic of Timor-Leste (East Timor)	Stratified random sample strategy (WHO guidelines)	T: 1042	12-17	--	66.7%	1.82	0.04	0.01	1.87	--		
			--	12-14	--	66.3%	1.79	0.04	0.00	1.84	--		
			--	15-17	--	67.2%	1.86	0.05	0.00	1.91	--		
			Male: 543	--	--	61.6%	1.60	0.04	0.01	1.65	--		
			Female: 487	--	--	71.4%	2.03	0.04	0.00	2.07	--		

Appendix 1C: Caries Experience and Socioeconomic Status (SES)

Study, Authors & study years	Location	Within social rank	Age	Number of subject	F (ppm)	SES level	Caries (%)	D	M	F	DMFT	SD	DMFS	SD
(Singh 1999)	Faridabad, India	Rural	12-16 y.o	86	--	1*	--	1.00	0.03	0.00	1.03	--	--	--
(Cho et al, 2014)	Cheongju, South Korea	Semi-Urban	6-11 y.o	1485	1ppm	2**	--	--	--	--	--	--	--	--
			8 y.o	106	--	--	--	0.01	0.00	0.39	0.40	0.85	0.58	1.33
			11 y.o	104	--	--	--	0.05	0.00	0.89	0.94	1.50	1.54	2.73
(Dixit 2013)	Chandybhanjyang, Chepang, Nepal	Rural	5-16 y.o	361	--	3***	--	--	--	--	--	--	--	--
			5-6 y.o	--	--	--	52	--	--	--	1.59	--	--	--
			12-13 y.o	--	--	--	41	--	--	--	0.84	--	--	--
(Popoola 2013)	Ibadan, Nigeria	Urban	1-15 y.o	209	--	--	52.2	--	--	--	0.63	1.31	--	--
			1-5 y.o	39	--	--	--	--	--	--	--	--	--	--
			6-10 y.o	112	--	--	--	--	--	--	1-3	--	--	--
			11-15 y.o	8	--	--	--	--	--	--	1-3	--	--	--
				118	--	1*	46.9	--	--	--	0.69	1.42	--	--
				72	--	2**	40.5	--	--	--	0.62	1.27	--	--
				19	--	3**	12.6	--	--	--	0.36	0.67	--	--
(Suprabha, 2013)	Mangalore' India	Rural	11-13 y.o	858	--	1* & 3***	59.4	--	--	--	1.52	1.8	--	--
							--	--	--	--	1.6	1.9	--	--
						1* 3***	--	--	--	--	1.46	1.6		

Study, Authors & study years	Location	Within social rank	Age	Number of subject	F (ppm)	SES level	Caries (%)	D	M	F	DMFT	SD	DMFS	SD
(Balan 2013)	Iasi district	Semi-Urban	10-19 y.o	2654	--	--	--	--	--	--	--	--	--	--
			10-14 y.o	1156	--	--	84.72	1.05	0.50	0.8	2.35	1.45	--	--
			15-19 y.o	1498	--	--	88.03	1.92	0.7	1.34	3.96	0.87	--	--
						1*	--	0.57	0.2	0.37	1.23	0.7	--	--
						2**	--	0.88	0.41	0.16	1.45	2.2	--	--
						3***	--	1.86	0.7	0.2	2.76	1.27	--	--
(Reddy 2013)	Bhopal. Madhya Pradesh, Central India	Semi-Urban	7-17 y.o	143	--	3***	--	--	--	--	--	--	--	--
				65(HI)	--	--	--	1.38	0.02	0	1.4	1.95	--	--
				48(VI)	--	--	--	1.02	0.02	0	0.94	1.45	--	--
(Loyola 2007)	Hidalgo, Mexico	Urban	12 & 15 y.o	1538	1.38 -3.07	--	48.6	0.83	0.05	0.28	1.5	1.72	--	--
			12 y.o	688		--	--	0.73	0.04	0.18	0.90	1.33	--	--
			15 y.o	850		--	--	0.9	0.05	0.36	1.36	1.95	--	--
						4****	42.7	--	--	--	0.95	1.50	--	--
						3***	48.0	--	--	--	1.16	1.76	--	--
						2**	51.5	--	--	--	1.14	1.57	--	--
						1*	51.9	--	--	--	1.31	1.88	--	--

** High level SES, ** Mid-level SES, *** Low level SES, **** Very low level (Poorest) SES*

Appendix 1D: Oral Hygiene Habits and Caries Prevalence

Study, Authors and years of study	Country (Study location)	Age	Social rank	Number of subject	Gender	Oral hygiene method used and frequency of tooth brushing	(%)	Caries Prevalence
(Wong 2001)	Guangdong, China	5-12 y.o	Urban & Rural	3163	--	--	--	84.0
		12 y.o	Urban	796	--	Use toothbrush	81	41.0
		12 y.o		782		Take less sugar	52	
		12 y.o				Rinse mount after eating	23	
		12 y.o				Visit a dentist	12	
		12 y.o				Use fluoride toothpaste	4	
		12 y.o				Others	7	
		12 y.o				Don't know	7	
		12 y.o				Brush once a day	77	
		12 y.o				Brush twice a day	22	
		12 y.o	Rural			Use toothbrush	48	42.0
		12 y.o				Take less sugar	36	
		12 y.o				Rinse mount after eating	11	
		12 y.o				Visit a dentist	7	
		12 y.o				Use fluoride toothpaste	1	
		12 y.o				Others	5	
		12 y.o				Don't know	33	
		12 y.o				Brush once a day	67	
		12 y.o				Brush twice a day	31	
(AusAID 2002)	Timor-Leste	6-17 y.o	Urban and Rural	--	--	--	--	--
		6-8		143	M & F	Use toothbrush & toothpaste	58.7	72.6
		9-11		189	M & F	Use toothbrush & toothpaste	71.9	46.9
		12-14		261	M & F	Use toothbrush & toothpaste	91.7	66.3
		15-17		217	M & F	Use toothbrush & toothpaste	98.2	67.2

Study, Authors and years of study	Country (Study location)	Age	Social rank	Number of subject	Gender	Oral hygiene method used and frequency of tooth brushing	(%)	Caries Prevalence
		6-8	Urban and Rural	--	M & F	Brush once a week	7.3	72.6
		6-8			M & F	Brush several times a week	9.7	
		6-8			M & F	Brush once a day	46.1	
		6-8			M & F	Brush twice a day	33.3	
		6-8			M & F	Brush three times day	3.6	
		12-14	Urban and Rural	--	M & F	Brush once a week	1.8	66.3
		12-14			M & F	Brush several times a week	1.1	
		12-14			M & F	Brush once a day	34.7	
		12-14			M & F	Brush twice a day	56.2	
		12-14			M & F	Brush three times a day	6.2	
(Zhu 2003)	China	12 y.o	Urban and Rural	4400	--	Seldom or no brush	16.8	--
		12 y.o				Brush once a day	38.2	
		12 y.o				Brush twice a day	45.0	
		12 y.o				Horizontal brushing method	29.3	
		12 y.o				LTD-recommended methods	55.1	
		12 y.o				No systemic methods	15.7	
		18 y.o	Urban & Rural	4400	--	Seldom or no brushing	5.8	
		18 y.o				Brush once a day	50.3	
		18 y.o				Brush twice a day	43.9	
		18 y.o				Horizontal brushing method	23.3	
		18 y.o				LTD-recommended methods	49.0	
		18 y.o				No systemic methods	27.7	
(Polk 2010)	Pennsylvania, USA	Grades 1,3,9 & 11	Urban	6040	--	Brush less than once per day	2.2	--
		Grades 1,3,9 & 11				Brush once a day	22.7	
		Grades 1,3,9 & 11				Brush twice a day	55.5	
		Grades 1,3,9 & 11				Brush more than twice a day	19.6	

Study, Authors and years of study	Country (Study location)	Age	Social rank	Number of subject	Gender	Oral hygiene method used and frequency of tooth brushing	(%)	Caries Prevalence
(Reddy 2013)	Bhopal. Madhya Pradesh, Central India	7-17 y.o	Semi-Urban	143	--	--	--	--
		7-17 y.o		90	HI children	Use toothpaste	94.7	
		7-17 y.o		5		Use toothpowder	5.3	
		7-17 y.o		81		Brush once a day	85.3	
		7-17 y.o		14		Brush twice a day	14.7	
		7-17 y.o		44	VI children	Use toothpaste	91.6	
		7-17 y.o		4		Use toothpowder	8.4	
		7-17 y.o		41		Brush once a day	85.4	
		7-17 y.o		7		Brush twice a day	14.6	
(Cook 2008)	Calnali-Hidalgo, Mexico	2-18 y.o	Rural Villages	248	--	Toothbrush & parents help brush	--	95-100
		2-18 y.o	-Village 1	25		Use toothbrush	96.2	
		2-18 y.o	-Village 2	39		Use toothbrush	97.5	
		2-18 y.o	-Village 3	34		Use toothbrush	75.6	
		2-18 y.o	-Village 4	31		Use toothbrush	91.2	
		2-18 y.o	-Village 5	36		Use toothbrush	94.7	
		--	--	--	--	--	--	--
		2-18 y.o	-Village 1	13		Parents help brush	50.0	
		2-18 y.o	-Village 2	3		Parents help brush	7.5	
		2-18 y.o	-Village 3	14		Parents help brush	31.1	
		2-18 y.o	-Village 4	5		Parents help brush	14.7	
		2-18 y.o	-Village 5	11		Parents help brush	28.2	
(Al-Majed 2011)	Riyadh, Saudi Arabia	8-10 y.o	Urban	522	--	Use toothbrush	--	76.4
		8-10 y.o		57		Not brush	10.9	
		8-10 y.o		104		Brush once a month	19.9	
		8-10 y.o		218		Brush once a week	41.8	
		8-10 y.o		86		Brush once a day	16.5	
		8-10 y.o		57		Brush twice a day	10.9	

Study, Authors and years of study	Country (Study location)	Age	Social rank	Number of subject	Gender	Oral hygiene method used and frequency of tooth brushing	(%)	Caries Prevalence
(Gathecha 2012)	Nairobi West and Mathira West, Kenya	12 y.o	Urban & Rural	639	--	Use toothbrush & stick	--	--
		12 y.o	Urban(Nairobi west)	322	--	Toothbrush and toothpaste	96.0	37.5
		12 y.o		4		Chewing stick**	1.2	
		12 y.o		21		Others (salty water, charcoal, limestone)	2.8	
		12 y.o		12		Brush less than daily	3.5	
		12 y.o		122		Brush once a day	35.2	
		12 y.o		213		Brush twice or more a day	61.4	
		12 y.o	Rural (Mathira west)	192	--	Use toothbrush and toothpaste	66.0	24.0
		12 y.o		88		Chewing stick	30.0	
		12 y.o		12		Others (salty water, charcoal, limestone)	4.0	
		12 y.o		10		Brush less than daily	3.0	
		12 y.o		152		Brush once a day	52.0	
		12 y.o		130		Brush twice or more a day	45.0	
(Mafuvadze 2013)	Harare & Bikita, Zimbabwe	12 y.o	Urban & Rural	172	--	--	--	--
		12 y.o	Urban	53	--	Use toothbrush and toothpaste	50.9	59.5
		12 y.o		26		Use toothbrush only	76.9	
		12 y.o		0		Chewing stick	0	
		12 y.o		0		None	0	
		12 y.o		20		Consulted a dentist at least once	70.0	
		12 y.o		31		Brush once a day	64.5	
		12 y.o		41		Brush twice a day	56.1	
		12 y.o		7		Brush after every major meal	57.1	
		12 y.o		0		Brush less often than daily	0	
		12 y.o	Rural	25	--	Use toothbrush and toothpaste	24.0	40.8

Study, Authors and years of study	Country (Study location)	Age	Social rank	Number of subject	Gender	Oral hygiene method used and frequency of tooth brushing	(%)	Caries Prevalence
		12 y.o		33		Use toothbrush only	39.4	
		12 y.o		29		Chewing stick	48.3	
		12 y.o		6		None	83.3	
		12 y.o		3		Consulted a dentist at least once	66.6	
		12 y.o		40		Brush once a day	40.0	
		12 y.o		18		Brush twice a day	38.9	
		12 y.o		29		Brush after every major meal	34.5	
		12 y.o		6		Brush less often than daily	83.3	
(Gupta 2014)	Mathura City, India	12 y.o	Urban	100	--	--	--	--
		12 y.o		54	Male	Use toothbrush and toothpaste	90	
		12 y.o		4		Toothbrush with toothpowder	8	
		12 y.o		1		Chewing stick	2	
		12 y.o		38		Brush once a day	76	
		12 y.o		12		Brush twice a day	24	
		12 y.o		50	Female	Use toothbrush and toothpaste	100	
		12 y.o		0		Use toothbrush with toothpowder	0	
		12 y.o		0		Chewing stick	0	
		12 y.o		31		Brush once a day	62	
		12 y.o		19		Brush twice a day	38	
(Dixit 2013)	Chepang, Nepal	11-13 y.o	Rural	--	--	--	--	--
		11-13 y.o		37		Clean teeth daily	56	
		11-13 y.o		105		Rinse mouth daily	80	
		11-13 y.o		31		Brushes twice daily	24	
		11-13 y.o		113		Use toothbrush and toothpaste	87	
(Balan 2013)	Iasi district, Romania	10-19 y.o	Semi-Urban	2654	--	--	--	--
		--	--	--	--	Brush once a day:	--	84.72

Study, Authors and years of study	Country (Study location)	Age	Social rank	Number of subject	Gender	Oral hygiene method used and frequency of tooth brushing	(%)	Caries Prevalence
		10-14 y.o				-SES 1	28.23	
		10-14 y.o				-SES 2	52.5	
		10-14 y.o				-SES 3	63	
		--				Brush twice a day:	--	
		10-14 y.o				-SES 1	52.47	
		10-14 y.o				-SES 2	26.78	
		10-14 y.o				-SES 3	17.65	
		--				Brush three time a day or more:	--	
		10-14 y.o				-SES 1	9.47	
		10-14 y.o				-SES 2	10.46	
		10-14 y.o				-SES 3	1.55	
(Suprabha 2013)	Mangalore' India	11-13 y.o	Semi-Urban	858	--	--	--	59.4
		11-13 y.o	--	240	--	High knowledge group:	--	61.7
				63		- Brush once a day	16.2	
		11-13 y.o		327		- Brush twice a day	83.8	
		11-13 y.o		381		- Use toothbrush	97.7	
		11-13 y.o		376		- Use toothpaste	96.4	
		11-13 y.o		10		- Use toothpowder	2.6	
		11-13 y.o		4		- Use Charcoal/others	1.1	
		11-13 y.o		100		- Use horizontal strokes brushing method	25.6	
		11-13 y.o		217		- Up and down strokes brushing method	55.6	
		11-13 y.o		86		- No systemic method	22.1	
					--			
		11-13 y.o		266		Low knowledge group:	--	56.8
		11-13 y.o		90		- Brush once a day	19.2	
		11-13 y.o		376		- Brush twice a day	80.4	
		11-13 y.o		455		- Use toothbrush	97.2	
		11-13 y.o		446		- Use toothpaste	95.3	

Study, Authors and years of study	Country (Study location)	Age	Social rank	Number of subject	Gender	Oral hygiene method used and frequency of tooth brushing	(%)	Caries Prevalence
		11-13 y.o		12		- Use toothpowder	2.6	
		11-13 y.o		10		- Use Charcoal/others	2.1	
		11-13 y.o		124		- Use horizontal strokes brushing method	26.5	
		11-13 y.o		259		- Up and down strokes brushing method	55.3	
		11-13 y.o		120		- No systemic method	25.6	
(Paredes 2009)	Paraiba, Brazil	3-13	Urban	--	--	Without Caries:	--	--
				65	--	-Use toothbrush	32.5	
				31		-Brush with assistance	51.7	
				14		-Don’t use toothbrush	22.2	
				29		-Use dental floss	43.3	
				59		-Don’t use dental floss	32.3	
				12		- Brush once a day	37.5	
				29		- Brush twice a day	35.8	
				55		- Brush 3 times a day or more	37.4	
				--		With Caries:	--	--
				135		- Use toothbrush	--	67.5
				29		- Brush with assistance	--	48.3
				49		- Don’t use toothbrush	--	77.8
				38		- Use dental floss	--	56.7
				123		- Don’t use dental floss	--	67.6
				20		- Brush once a day	--	62.5
				52		- Brush twice a day	--	64.2
				92		- Brush 3 times a day or more	--	62.6

Appendix 2

Parents/Carers Information Sheet

(*Confidential*)

"The Oral Health of Children in the District of Dili, Timor-Leste"

Parents/Carers Information Sheet

Schoolchildren in Dili are participating in a survey to collect information relevant to develop an oral health status profile of children and to inform subsequent development of oral health prevention strategic for the district of Dili, Timor-Leste. This study is being conducted by Dr Lucio Babo Soares, a PhD student of Center for Rural Health, School of Health Science, Faculty of Health - University of Tasmania, Australia.

The Aim of This Study

The survey aimed to develop a 2014 oral health status profile of children aged 6 to 17 years in the district of Dili, Timor-Leste. Additionally, the study set out to investigate the change in the oral health status of children living in Dili between 2002 and 2014, and any differences in dental caries experience and mean number of teeth with active dental caries between children from low compared to mid-high socioeconomic schools. There were two components to the epidemiological survey: an oral health behaviours questionnaire and an oral examination.

Why Has My Child Been Invited to Participate in This Survey?

All schoolchildren in Dili district are invited to participate in the study.

What Does This Study Involve?

Your child participation in this study involves answering the attached questionnaire and undergoing a dental examination. You will be invited to:

- Administer a questionnaire on behalf of your child. The questionnaire will collects information on socio-demographic data, oral health behaviour and dental visiting pattern. If you give consent on behalf your child to participate in the survey you will be invited to complete the questionnaire. The questionnaire should not take more than 10 minutes to complete and will be collected before commencing clinical examination.
- Upon completion of the questionnaire your child will undergo a dental examination. The clinical examination will be conducted at the child classroom where you will be seated in a proclined position under natural sunlight. You will be asked to stand up or sit down in front of your child when the examination is taking place. Your child will not be treated on this step. All we will be carried out is to check for your child's dental status by using a set of diagnostic instruments and materials. The examination should take about 10 minutes to complete.

Prior to fill up the questionnaire, you will be asked to give consent on behalf of your child by signed a consent form provided by the researcher. Only children who their parents/carers have given consent will be allowed to participate in the survey. Your children are free to participate or withdraw from the survey any time. Your child is free to say no to take part in the survey. There are no specific consequences for those who do not want to be involved in this survey. Your child's personal details will not be seen anywhere during and after the completion of the survey. All information collected will be treated in a confidential manner and will be stored in a file cabinet in the School of Medicine, University of Tasmania.

The Benefits from Participation in This Survey

Your child is likely to benefit from enhancing his/her knowledge about dental caries and periodontal disease in general. In specific, he/she will have opportunity to understand how to maintain your good oral hygiene as well as how to prevent themselves from dental caries and periodontal disease.

The Risks from Participation in This Survey

There is a chance that your child will feel embarrassed and tired during opening his/her mouth for dental examination or while the clinician/researcher is being checked and scored their caries and periodontal indices in their mouth. It will be possible that your child can decline to ask time for rest while his/her teeth are being scored. In such case he/she can raise hand signalling the researcher to cease and give a few minutes for rest. If you child feel discomfort of any aspect of the examination he/she can ask the clinician/researcher to explain about the examination procedures before scoring teeth index continued.

For How Long Will the Information Be Stored after the Completion of This Study?

All the dental examination records, questionnaires and interviewed transcripts will be stored in a file cabinet in the School of Medicine, University of Tasmania. Computers data and files will placed in a secure drive and will only be assessed with a secret password. Transcripts (hard copy and electronic) will be disposed immediately after 5 years.

The researchers will treat all the information collected from your child in a confidential manner. All participants will be reminding about the importance of the confidentiality. However, we cannot guarantee that other colleagues will maintain the confidentiality of the information gathered.

What if I Have Question Regarding the Survey?

You can contact the main investigator of the research if you have any question about the study. The researchers' details are listed below,

In Tasmania, Australia

Dr Lucio Frederico Babo Soares
Ph:
Email:
Home address: -Tasmania, Australia.

In Dili, Timor-Leste

Home address: Dili, Timor-Leste
Email:
Ph:

This study has been approved by the **Tasmanian Health and Medical Human Research Ethics Committee.** If you have complains about the conduct of this study, should contact Executive Officer of the HERC (Tasmanian) Network on (03)62267479 or Email: human.ethics@utas.edu.au.

Lots of thanks for taking your time considered this research. If you are willing to let your child participate in the study please sign the attached consent form, complete the questionnaire, return it to examination recorder and undergo the dental examination. Please keep this information sheet with you.

Appendix 3

Parents/Carers Information Sheet (Tetum version)

(Konfidensial)

"Saude Oral Labarik Nian Iha Distritu Dili, Timor-Leste"

Formulario Informasaun Ba Inan-Aman

Estudantes hotu iha Dili sei participa iha survei ida nebe koleta informasaun relevante atu desinvolve profile saude ibun ho nihan nomos atu informa desinvolvemento subsequente ba estrategia prevensaun saude oral iha distritu Dili, Timor-Leste. Estudo ne'e sei halao husi Dr Lucio Babo Soares, estudate doutoramento (PhD student) husi Center for Rural Health, School of Health Science, Faculty of Health - University of Tasmania, Australia

Objetivo estudo

Objetivo husi estudu ne'e atu koleta informasaun nebe sei uza atu desinvolve profile saude ibun ho nihan labarik eskolantes tinan 6 – 17 nebe sei participa iha "Survei Saude Oral Labarik Sira Nian Iha Distritu Dili, Timor-Leste ". Estudo ne'e mos atu investiga alterasaun status saude oral labarik sira nebe hela iha Dili entre tinan 2002 to 2014, no investiga mos diferencias dental caries experience no mean active dental caries entre labarik eskolas husi grupo socioeconomic (SES) level kraik kompara ho grupo (SES) husi level medio ba leten. Iha komponenti rua husi estudu ne'e: questionario no examinasaun oral.

Participasaun Labarik Nian Iha Estudu Ne'e:

Estudantes/labarik hotu iha distritu Dili sei konvida atu participa iha estudu referidu.

Saida Deit Mak Estudu Ne'e Involve?

Ita nian oan nebe participa iha estudu ne'e sei hatan ou responde perguntas iha kuisionario ami anexa hamutuk ho surat ne'e, no tuir ezaminasaun ibun ho nihan/dentaria. Ami sei konvida Ita Bo'ot hodi:

- Prience kuestionario nebe temi ona iha leten eim nome Ita nia oan nian. Kuestionario ne'e koleta infromasaun konaba dadus socio-demografika, attitude saude oral no visitas ba dentista. Wainhira Ita Bo'ot hato konsente ba Ita nian oan hodi participa iha survey ne'e, ami sei konvida Ita hodi kompleta kuestionario ne'e. Kuestionario ne'e sei kompleta no rekolha kedas antes hala'o ezaminasaun dentaria.Tempu 10 minitos presiza ba kompleta kuestionario ne'e.
- Wainhira kompleta ona kuestionario ne'e, ami sei admiti Ita Bo'ot nian oan ba tuir ezaminasaun saude ibun ho nihan/dentaria. Ezaminasaun ne'e sei hala'o iha klase laran/aula eskola nian ne'ebe labarik sira sei hatur iha kadeira ho pozisaun halis/sadere itoan ba kotuk no utiliza naroman husi loron. Ita Bo'ot sei akompanha Ita nian oan durente ezaminasaun. Ami sei la halo tratamento ba Ita nia oan, maibe ami sei ezamina/periksa deit labarik nian saude ibun ho nihan utiliza equipamentos diagnostiku no materiais dentaria balun. Ezaminasaun ne'e lori tempu 10 minutos deit.

Antes kompleta kuestionario, ami sei husu ita nian desponiveldade atu hato konsente eim nome Ita nia oan nian liu husi asina Formulario Konsente ida nebe peskizador sira prepara ona. Labarik sira nebe hetan konsente husi inan/aman mak bele participa iha estudu ne'e. Ita Bo'ot nia oan iha liberdade total atu participa ou rezeita participasaun husi survey ne'e iha kualker tempu. Sei la iha konsekwensias ba labarik sira nebe lakohi participa iha estudu referidu. Detailas indentidade husi Ita nia oan nian sei la publika durante no depois survey ramata. Informasaun hotu nebe ami koleta husi Ita nia oan sei trata konfidensialmente no sei rai metin iha gabinete Fakuldade Medicina, Universidade Tasmania nian.

Benefisios Husi Participasaun Iha Survey Ne'e?

Geralmente, participasaun iha survey ne'e sei hasa'e Ita Bo'ot nia oan nian kunhesementu kona ba karies nihan no moras periodontal. Espesifikamente, Ita nian oan sei hetan oportunidade atu kumpriende oinsa mantein higeniku oral nomos oinsa prevene nia a'an husi moras periodontal no karies nihan.

Riskus Husi Participasaun Iha Estudu Ne'e?

Wainhira kliniku/peskizador ezamina hela labrik nian indeks nihan ho periodontal, iha posibilidade nia bele senti moe no kole tamba rasaun pesoal ruma. Maibe, nia bele husi tempu hodi deskansa itoan tamba rasaun nebe temi ona iha leten. Karik nia senti descomforto ho aspetu balun husi prosedura ezaminasaun ne'e mak nia bele husu ba kliniku ka peskizador ne'e atu fo esplikasaun kona ba prosedura referidu.

Wainhira Estudu Ne'e Ramata, Dadus/Informasaun Ne'e Sei Rai Iha Nebe No To'o Bainhira?

Informasaun/dadus nebe koleta liu husi kuisionarios, ezaminasaun no intervistas sei rai iha gabinete Fakuldade Medicina, Universidade Tasmania. Dadus no file sira nebe komputerizidu sei halot iha drive sekretu ida no sei asesu uza password sekretu. Transkripsaun hanesan (hard copy no elektronika) sira sei halakon/sunu depois de tinan lima.

Peskizador sira sei trata informasaun hotu nebe koleta ona ho maneiras konfidensial. Ami sei fo mos hanoin ba participantes hotu konaba importansia husi konfidensialidade ne'e. Maibe, ami la bele garante katak kolega sira nebe mak asiste survey ne'e mos bele mantein konfidensialidade ba informasaun koletadu.

Bele Hato Perguntas Konaba Estudu Ne'e Ka Lae?

Ita bele kontaktu premeiro peskizador wainhira iha perguntas ruma konaba estudu referidu. Detailas konaba peskizador ne'e nian, lista iha kraik ne'e:

Iha Tasmania, Australia

Dr Lucio Frederico Babo Soares
Ph: 0415118867
Email:
Enderesu uma: -Tasmania, Australia.
Iha Dili, Timor-Leste:
Enderesu uma: , Dili, Timor-Leste
Email:
Ph: +

Survey ne'e hetan ona aprovasaun husi Komisaun Etika Ba Asuntos Saude no Medicina Geral, Tasmania (Tasmanian Health and Medical Human Research Ethics Committee). Karik iha komplain ruma konaba kodiku konduta husi estudu ne'e, favour kontaktu: Executive Officer of the HERC (Tasmanian) Network on (03)62267479 or Email: human.ethics@utas.edu.au.

Karik laran kma'an autoriza Ita Bo'ot nian oan participa iha estudo ne'e, por favour asina Formulario Konsente (anexo) no kompleta Kuisionario (anexo) no fo fila dokumentus sira ne'e mai perkizador hodi tuir mai ba atende ezaminasaun saude ibun ho nihan/dentaria. Formulario informasaun ne'e hela ba Ita Bo'ot. Obrigadu Wain ba konsidersaun no tempu nebe fo ona ba peskiza ne'e.

Appendix 4

Information Sheet for the Participants

(*Confidential)*

"The Local Survey of Children Oral Health Status in the District of Dili, Timor-Leste"

Participants Information Sheet for School-Children in the District of Dili, Timor-Leste

(Dental Examination and Questionnaire)

You are invited to take part in a survey to collect information relevant to develop an oral health status profile of children and to inform subsequent development of oral health prevention strategic for the district of Dili, Timor-Leste. This study is being conducted by Dr Lucio Babo Soares, a PhD student of Center for Rural Health, School of Health Science, Faculty of Health - University of Tasmania, Australia.

The Aim of This Study

The survey aimed to develop a 2014 oral health status profile of children aged 6 to 17 years in the district of Dili, Timor-Leste. Additionally, the study set out to investigate the change in the oral health status of children living in Dili between 2002 and 2014, and any differences in dental caries experience and mean number of teeth with active dental caries between children from low compared to mid to high socioeconomic schools. There were two components to the epidemiological survey: an oral health behaviours questionnaire and an oral examination.

What Does the Study Involve?

If you are selected to participate in the survey, you will be asked to do the following:

1. Complete a questionnaire about your experiences and opinions on oral health behaviour and dental visiting pattern. The questionnaire also collects information on socio-demographic data. Those of you who give consent to participate in the survey will be invite to complete questionnaire. The questionnaire should take no more than 10 minutes to be completed and will be collected before commencing clinical examination.
2. Upon completion of the questionnaire you will be invited to attend dental examination. The clinical examination will be conducted at your classroom where you will be seated in a proclined position under natural sunlight. You will not be treated on this step. All we will be carried out is to check for your dental status by using a set of diagnostic instruments and materials. The examination should not take more than 10 minutes.

Prior to fill up the questionnaire and undergo the clinical examination, your parents/carers will be asked to give consent on behalf of you by signed a consent form provided by the researcher. Only those who give consent will be allowed to participate in the survey. You are free to participate or withdraw from the survey any time. You are free to say no to participate in the survey if you feel uncomfortable with the survey procedures. There are no specific consequences for those of you who do not want to be involved in this survey. Your personal detail will not be seen anywhere during and after the completion of the survey. All information collected will be treated in a confidential manner and will be stored in a file cabinet in the School of Medicine, University of Tasmania.

The Benefits from Participation in This Survey:

By participation in this survey you will be benefit from enhancing your information as well as knowledge about dental caries and periodontal disease in general. In specific, you will have opportunity to understand how to maintain your good oral hygiene as well as how to prevent yourself from dental caries and periodontal disease.

The Risks from Participation in This Survey:

There is a chance you will feel embarrassed and tired during opening your mouth for dental examination or while the clinician/researcher is being checked and scored your caries and periodontal indices in your mouth. It will be possible that you can decline to ask time for rest while your teeth are being scored. In such case you can raise your hand signalling the researcher to cease and give you a rest for a few minutes. If you feel discomfort of any aspect of the examination you can ask the clinician/researcher to explain about the examination procedures before the scoring of teeth index commenced.

For How Long Will the Information Be Stored after the Completion of This Study?

All the dental examination records, questionnaires and interviewed transcripts will be stored in a file cabinet in the School of Medicine, University of Tasmania. Computers data and files will placed in a secure drive and will only be assessed with a secret password. Transcripts (hard copy and electronic) will be disposed immediately after 5 years.

The researchers will treat all the information collected in a confidential manner. All participants will be reminding about the importance of the confidentiality. However, we cannot guarantee that other colleagues will maintain the confidentiality of the information gathered.

What if I Have Question Regarding the Survey?

You can contact the main investigator of the research if you have any question about the study.

The researchers' details are listed below:

In Tasmania, Australia:

Dr Lucio Frederico Babo Soares
Ph:
Email:
Home address: -Tasmania, Australia.

In Dili, Timor-Leste:

Address: , Dili, Timor-Leste
Email:
Ph: +

This study has been approved by the Tasmanian Health and Medical Human Research Ethics Committee. If you have complains about the conduct of this study, should contact Executive Officer of the HERC (Tasmanian) Network on (03)62267479 or Email: *human.ethics@utas.edu.au*.

Lots of thanks for taking your time considered this research. If you are willing to participate in the study and one of your parents have signed the attached consent form, complete the questionnaire, return it to examination recorder and undergo the dental examination. Please keep this information sheet with you.

Appendix 5

Information Sheet for the Participants (Tetum Version)

(Konfidensial)

"Survei Saude Oral Labarik Nian Iha Distritu Dili, Timor-Leste"

Formulario Informasaun ba Participantes iha Distritu Dili, Timor-Leste

(Ezaminasaun Dentaria no Kuisionario)

Ho hakraik a'an ami mai konvida Ita Bo'ot atu hola parte iha survei nebe sei koleta informasaun relevante atu desinvolve profile saude ibun ho nihan nomos atu informa desinvolvemento subsequente ba estrategia prevensaun saude oral iha distritu Dili, Timor-Leste. Estudo ne'e sei halao husi Dr. Lucio Frederico Babo Soares, husi Center for Rural Health, School of Health Science, Faculty of Health - University of Tasmania, Australia.

Objetivo Peskiza/Survey:

Objetivo husi estudu ne'e atu koleta informasaun nebe sei uza atu desinvolve profile saude ibun ho nihan labarik eskolantes tinan 6 – 17 nebe sei participa iha "Survei Saude Oral Labarik Sira Nian Iha Distritu Dili, Timor-Leste ". Estudo ne'e mos atu investiga alterasaun status saude oral labarik sira nebe hela iha Dili entre tinan 2002 to 2014, no investiga mos diferencias dental caries experience no mean active dental caries entre labarik eskolas husi grupo socioeconomic (SES)level kraik kompara ho grupo (SES) husi level medio ba leten. Iha komponenti rua husi estudu ne'e: questionario no examinasaun oral.

Participasaun Labarik Nian Iha Estudu Ne'e:

Estudantes/labarik hotu iha distritu Dili sei konvida atu participa iha estudu referidu.

Saida Deit Mak Estudu Ne'e Involve?

Wainhira Ita Bo'ot selesionadu hodi participa iha survey ne'e maka ami sei husu Ita atu haktuir buat sira tuir mai ne'e:

1. Adminintra kuestionario nebe temi ona iha leten. Kuestionario ne'e koleta infromasaun konaba dadus socio-demografika, attitude saude oral no visitas ba dentista. Wainhira Ita Bo'ot hato konsente hodi participa iha survey ne'e, ami sei konvida Ita hodi kompleta kuestionario referidu. Kuestionario ne'e sei kompleta no rekolha kedas antes hala'o ezaminasaun dentaria. Presiza tempu 10 minutos deit ba kompleta kuestionario ne'e.
2. Wainhira kompleta ona kuestionario ne'e, ami sei admiti Ita Bo'ot ba tuir ezaminasaun saude ibun ho nihan/dentaria. Ezaminasaun ne'e sei hala'o iha klase laran/aula eskola nian ne'ebe labarik sira sei hatur iha kadeira ho pozisaun halis/sadere itoan ba kotuk no utiliza roman husi loron. Ita Bo'ot nia inan-aman ka parente sei akompanha Ita durante

ezaminasaun. Ami sei la halo tratamento ba Ita, maibe ami sei halo ezamina/periksa deit Ita Bo'ot nian saude ibun ho nihan utiliza equipamentos diagnostiku no materiais dentaria balun. Ezaminasaun ne'e lori tempu 10 minutos deit.

Antes kompleta kuestionario, ami sei husu ita nian inan-aman nian desponiveldade atu hato konsente eim nome Ita Bo'ot nian liu husi asina Formulario Konsente ida nebe peskizador sira prepara ona. Labarik sira nebe hetan konsente husi inan/aman mak bele participa iha estudu ne'e. Ita Bo'ot iha liberdade total atu participa ou rezeita participasaun husi survey ne'e iha kualker tempu. Sei la iha konsekwensias ba labarik sira nebe lakohi participa iha estudu referidu. Detailas indentidade husi Ita Bo'ot nian sei la publika durante no depois survey ramata. Informasaun hotu nebe ami koleta husi Ita Bo'ot sei trata konfidensialmente no sei rai metin iha gabinete Fakuldade Medicina, Universidade Tasmania nian.

Benefisios Husi Participasaun Iha Survey Ne'e?

Geralmente, participasaun iha survey ne'e sei hasa'e Ita Bo'ot nian kunhesementu kona ba karies nihan no moras periodontal. Espesifikamente, Ita Bo'ot sei hetan oportunidade atu kumpriende oinsa mantein higeniku oral nomos oinsa prevene Ita a'an husi moras periodontal no karies nihan.

Riskus Husi Participasaun Iha Estudu Ne'e?

Wainhira kliniku/peskizador ezamina hela Ita Bo'ot nian indeks nihan ho periodontal, iha posibilidade Ita bele senti moe no kole tamba razaun pesoal ruma. Maibe, Ita Bo'ot bele husu tempu hodi deskansa itoan tamba rasaun nebe temi ona iha leten. Karik Ita senti descomforto ho aspetu balun husi prosedura ezaminasaun ne'e mak Ita bele husu ba kliniku ka peskizador ne'e atu fo esplikasaun kona ba prosedura referidu.

Wainhira Estudu Ne'e Ramata, Dadus/Informasaun Ne'e Sei Rai Iha Nebe No To'o Bainhira?

Informasaun/dadus nebe koleta liu husi kuisionarios, ezaminasaun no intervistas sei rai iha gabinete Fakuldade Medicina, Universidade Tasmania. Dadus no file sira nebe komputerizidu sei halot iha drive sekretu ida no sei asesu uza password sekretu. Transkripsaun hanesan (hard copy no elektronika) sira sei halakon/sunu depois de tinan lima.

Peskizador sira sei trata informasaun hotu nebe koleta ona ho maneiras konfidensial. Ami sei fo mos hanoin ba participantes hotu konaba importansia husi konfidensialidade ne'e. Maibe, ami la bele garante katak kolega balun nebe mak asiste survey ne'e mos bele mantein konfidensialidade informasaun koletadu.

Bele hato perguntas konaba estudu ne'e ka lae?

Ita Bo'ot bele kontaktu premeiro peskizador wainhira iha perguntas ruma konaba estudu referidu. Detailas konaba peskizador ne'e nian, lista iha kraik ne'e:

Iha Tasmania, Australia:

Dr Lucio Frederico Babo Soares
Ph:
Email:
Enderesu uma: , Australia.

Iha Dili, Timor-Leste:

Enderesu uma: Dili, Timor-Leste
Email:
Ph:

Survey ne'e hetan ona aprovasaun husi Komisaun Etika Ba Asuntos Saude no Medicina Geral, Tasmania nian (Tasmanian Health and Medical Human Research Ethics Committee). Karik iha komplain ruma konaba estudu ne'e, favour kontaktu: Executive Officer of the HERC (Tasmanian) Network on (03)62267479 or Email: human.ethics@utas.edu.au.

Karik laran kma'an autoriza Ita Bo'ot nian oan participa iha estudo ne'e, por favour asina Formulario Konsente (anexo) no kompleta Kuisionario (anexo) no fo fila dokumentus sira ne'e mai perkizador hodi tuir ezaminasaun saude ibun ho nihan/dentaria. Formulario informasaun ne'e hela ba Ita Bo'ot. Obrigado Wain ba konsidersaun no tempu nebe fo ona ba peskiza ne'e.

Appendix 6

Stakeholder Consultation Interview Questions

In the year 2002, experts from the University of Adelaide had conducted a National Oral Health Survey throughout Timor-Leste. The survey was carried out under the Australian – Timor-Leste National Oral health Project. Following the study, reports as well as few recommendations were submitted to the Ministry of Health of Timor-Leste to be implemented. The main objective of the recommendation was to improve oral health status of children and adults.

Questions:

1. Did you read the report of the Timor-Leste National Oral Health Survey and its recommendations? Were the Timor-Leste National Oral Health Survey and its recommendations important?
    - In what, if any, ways was the survey important?
    - In what, if any, ways were the recommendations important?
    - What survey results do you think were most significant?
    - What recommendations do you think were most significant?

2. Have the recommendations of the report been implemented?
    - What is the current stage of implementation?
    - Which recommendations have been fully implemented?
    - Which recommendations have been partially implemented?
    - Which recommendations have not been implemented at all?

3. If the respondent stated that the recommendations had not been implemented, he/she was asked: what were the main barriers implementing the recommendations?
    - Prompts for main barriers: Financial? Political, Bureaucratic support?
    - Infrastructure? Staffing? Transport? Community support?
    - Any other reasons?

Appendix 7

Stakeholder Consultation Interview Questions (Tetum Version)

Versaun Tetum

Iha tinan 2002, espertu sira husi Univesidade Adelaide halo tiha ona Survey Nasional Saude Oral iha Timor-Leste. Survey ne'e implementa liu husi the Australian – East Timor National Oral Health Project. Resultadu no rekomendasaun husi estudu ne'e hato'o ona ba Ministerio da Saude – Timor-Leste hodi implementa. Objetivu principal husi rekomendasaun sira ne'e atu hasa'e no hadia saude oral labarik no adultu sira nian.

Perguntas:

1. Ita Boot le'e ona Survei Nasional Saude Oral Timor-Leste tinan 2002 no ninia rekomendasaun sira? Survey ne'e no ninia rekomendasaun sira importante ka lae?
    - Oinsa mak survey ne'e importantante?
    - Oinsa mak rekomendasaun sira ne'e importante?
    - Resultadu ida nebe mak ita boot hanoin signifikante liu?
    - Rekomensaun sira nebe mak ita boot hanoin signifikadu liu?

2. Rekomendasaun sira ne'e implementa ona ka seidauk?
    - Etapa ida nebe mak implementa daudaun/hela?
    - Rekomendasaun sira nebe mak implementa ona?
    - Rekomendasaun sira nebe mak seidauk implementa hotu?
    - Rekomendasaun sira nebe mak seidauk implementa?

3. Karik responden hatan katak sedauk implementa maka pergunta tuir mai ne'e sei hato ba sira: Fatores saida deit mak konsidera nudar bareiras ba implemetasaun rekomendasaun sira ne'e?)

- Karik fatores sira tuir mai ne’e mak sai hanesan bareiras ba implementasaun: Financiamento, Politika? Suporta birokrasia? Infrastrutura? Staffing? Transporte? Suporta husi komunidade?
- Rasaun seluk?

Appendix 8

Ethics Approval

Office of Research Services
University of Tasmania
Private Bag 1
Hobart Tasmania 7001
Telephone + 61 3 6226 7479
Facsimile + 61 3 6226 7148
Email Human.Ethics@utas.edu.au
www.research.utas.edu.au/human_ethics/

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

10 October 2013
Dr Stella Stevens
C/- School of Medicine
University of Tasmania

Dear Dr Stevens
REF NO: H0013216
TITLE: The local survey of children oral health status in the district of Dili, Timor-Leste

Document	Version	Date
Protocol		
Neaf		19/9/2013
Parental Consent Form		19/9/2013
Child Examination Form		19/9/2013
Child Questionare (English and Tetum)		19/9/2013
Student Information Sheet		19/9/2013
Parental Information Sheet		19/9/2013
Ministry of Health General Director Letter of Support		8/10/2013

The Tasmanian Health and Medical Human Research Ethics Committee considered and approved the above documentation on **09 October 2013** to be conducted at the following site(s):

Timor-Leste

Please ensure that all investigators involved with this project have cited the approved versions of the documents listed within this letter and use only these versions in conducting this research project

This approval constitutes ethical clearance by the Health and Medical HREC. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approvals of other bodies or authorities are required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

All committees operating under the Human Research Ethics Committee (Tasmania) Network are registered and required to comply with the *National Statement on the Ethical Conduct in Human Research* (NHMRC 2007 updated 2009).

Therefore, the Chief Investigator's responsibility is to ensure that:

1. The individual researcher's protocol complies with the HREC approved protocol.
2. Modifications to the protocol do not proceed until **approval** is obtained in writing from the HREC. Please note that all requests for changes to approved documents must include a version number and date when submitted for review by the HREC.
3. Section 5.5.3 of the National Statement states:

Researchers have a significant responsibility in monitoring approved research as they are in the best position to observe any adverse events or unexpected outcomes. They should report such events or outcomes promptly to the relevant institution/s and ethical review body/ies and take prompt steps to deal with any unexpected risks.

The appropriate forms for reporting such events in relation to clinical and non-clinical trials and innovations can be located at the website below. All adverse events must be reported regardless of whether or not the event, in your opinion, is a direct effect of the therapeutic goods being tested. *http://www.research.utas.edu.au/human_ethics /medical_forms.htm*

4. All research participants must be provided with the current Patient Information Sheet and Consent Form, unless otherwise approved by the Committee.
5. The Committee is notified if any investigators are added to, or cease involvement with, the project.
6. This study has approval for 4 years contingent upon annual review. A *Progress Report* is to be provided on the anniversary date of your approval. Your first report is due **9/10/2014**. You will be sent a courtesy reminder closer to this due date.
7. *Final Report* and a copy of the published material, either in full or abstract, must be provided at the end of the project.

Should you have any queries please do not hesitate to contact me on (03) 6226 2764.

Yours sincerely

Lauren Black

Ethics Officer, Health and Medical Human Research Ethics Committee
Office of Research Services
Tel: +61 (03) 6226 2764
Email: lauren.black@utas.edu.au
University of Tasmania
Private Bag 01 Hobart Tas 7001

Appendix 9

Questionnaire

Questionnaire - for child sample

Office Use Only

Name School ..... District .....

Province ..... Date .....

Instruction

Please read each question and answer as best you can. Answers are either written on the dotted line or tick the appropriate box.

A. Personal Data

1. What is your child's full name : .....
2. What is your child's age: .....(in years)
3. What is your child's sex: Male ☐ Female ☐
4. What educational level did each parent/ guardians (who is currently living with child) achieve:

	Mother/Guardian	Father/Guardian
No schooling :	☐	☐
Elementary school :	☐	☐
Junior primary school :	☐	☐
High school :	☐	☐
College or trade :	☐	☐
Tertiary :	☐	☐

5. What is your usual occupation?

	Mother/Guardian	Father/Guardian
Farmer :	☐	☐
Manual worker :	☐	☐
Professional, administrative :	☐	☐
Private business :	☐	☐
Home duties :	☐	☐
Other :	☐	☐
If other, please, specify :	_____	_____

6. Which best describes your current living arrangement:

Own house ☐

Jointly own house with other family members ☐

Share house ☐

Rent house ☐

B. Dental Habits

1. Did your child brush his/her teeth yesterday :

Yes ☐

No ☐

2. Does your child ever brush his/her teeth :

Yes ☐

No ☐

(If yes, please go to questions 3 and 4. If no, go to question 5)

3. When did your child start brushing his/her teeth :

1 year old ☐

2 year old ☐

3 year old ☐

4 year old ☐

5 year old ☐

Don’t know ☐

4. How frequently does your child brush his/her teeth :

Once a week ☐

Several times a week ☐

Once a day ☐

Twice a day ☐

Three times or more a day: ☐

5. If you don’t use toothbrush to clean your teeth do you use anything else?

Please specify

6. Does your child use toothpaste:

Yes ☐

No: ☐

(If yes, please, go to questions 7. If no, go to question 8)

7. What kind of toothpaste does your child use:

Brand:

8. If you don’t use toothpaste to clean your teeth do you use anything else?

Please specify

C. Dental Care

1. Does your child use tooth picks?

Often ☐

Sometimes ☐

Never ☐

2. How long ago did your child last visit dentist for checkup or for dental treatment?

Less than 6 months ☐

Between 6 and 12 months ☐

Between 12 and 24 months ☐

More than 24 months ☐

Never been ☐

3. If your child has visited a dentist less than 24 months ago, did your child receive dental treatment at his/her last visit?

Yes ☐

No ☐

(If yes, please go to questions 4 and 5. If no, go to the Part?)

4. What was the reason for your child last visit (Please, tick one or more boxes):

Pain ☐

Tooth decay ☐

Bleeding gums ☐

Loose tooth ☐

Trauma ☐

For denture ☐

Check-up ☐

Other: ☐

(If other, please, specify)

5. What treatment did your child receive? (Please, tick one or more boxes):

Examination and prescription: ☐

Cleaning and scaling: ☐

Extraction: ☐

Filling: ☐

Denture: ☐

Other: ☐

(If other, please, specify)

D. IMPACT OF ORALHEALTH

1. During the last 12 months how often has your child had toothache?

   Very often ☐
   Often ☐
   Sometimes ☐
   Hardly ever ☐
   Never during the last 12 months ☐
   Don't know ☐

2. How often has your child felt unhappy about the appearance of teeth, or mouth during the last 12 months?

   Very often ☐
   Often ☐
   Sometimes ☐
   Hardly ever ☐
   Never during the last 12 months ☐
   Don't know ☐

3. How often has your child had to avoid eating some foods because of problems with teeth, or mouth during the last 12 months?

   Very often ☐
   Often ☐
   Sometimes ☐
   Hardly ever ☐
   Never (during the last 12 months) ☐
   Don't know ☐

Thank you for your contribution. Please take a moment to check that you have answered each question and then return this completed questionnaire to your child' teacher.

If you have any comments, please feel free to write them in the space below:

Appendix 10

Questionnaire (Tetum Version)

Kuestionario - EZEMPLO ba labarik nian

Naran Eskola ..... Sub-Distrito .....

Distrito ..... Data .....

INSTruksi

Favor le'e perguntas no respostas halo didiak. Resposta hato liu husi hakerek ou tik iha box nebe apropriadu

A. Data Pesoal

1. Naran kumpletu: .....
2. Tinan: .....
3. Sexo:

   Mane: ☐

   Feto: ☐

4. Level edukasan inan-aman/guardiaun nian (Sira nebe agora hela ho labarik iha uma):

	Inan/Guardiaun	Aman/Guardiaun
La eskola	☐	☐
Eskola primaria/SD	☐	☐
Eskola presekundario/SMP	☐	☐
Escola Secundario/SMA	☐	☐
Bacharelato(D1,D2,D3,etc)	☐	☐

Licenciatura/ Universidade	☐	☐

5. Ita nia okupasaun saida ?

	Inan/Guardiaun	Aman/Guardiaun
Agrikultor :	☐	☐
Badaen/Manual worker :	☐	☐
Funcionario :	☐	☐
Bisnis privadu/swasta :	☐	☐
Donu/a da casa :	☐	☐
Seluk :	☐	☐
Kari seluk, favor especifika :	_____	_____

6. Oinsa ita deskrobe ita nian hela fatin:

   Uma Rasik: ☐

   Hela hamutuk ho familia: ☐

   Share uma: ☐

   Aluga uma: ☐

B. Hahalok/Toman Saude Nihan *(Dental Habits)*

1. Ita nian oan kose nihan loro-loron ka lae?

   Sim: ☐

   Lae: ☐

2. Ita nia oan pernah kose nia nihan ka lae?

   Sim: ☐

   Lae: ☐

   (Karik kose duni, kontinua ba pergunta no: 3 ho 4. Karik lae, hakat ba pergunta no: 5)

3. Ita nia oan kumesa kose nihan iha tinan hira ?

   Tinan 1: ☐

   Tinan 2: ☐

Tinan 3: ☐

Tinan 4: ☐

Tinan 5: ☐

La hatene: ☐

4. Normalmente, ita nia oan kose nihan dala hira ?

Semana ida dala ida: ☐

Semana ida dala barak: ☐

Loron ida dala ida: ☐

Loron ida dala rua: ☐

Dala tolu / liu dala tolu: ☐

5. Karik uza buat seluk alien de eskova?

Favor especifika:

6. Ita nian oan uza pasta dente ka lae? :

Yes: ☐

No: ☐

(Karik uza, favor kontinua ba pergunta no 7. Karik lae, hakat ba pergunta no 8)

7. Ita nia oan uza pastadente saida?

Merek:

8. Se ita nia oan la uza pastadente hodi kose nihan, entaun nia uza saida?

Favor especifika:

C. Kuidadus Saude nihan *(Dental care)*

1. Ita nia oan uza paulitu/kesak hodi hamos nihan?

Bebeik: ☐

Dalaruma: ☐

Nunka: ☐

2. Hori bainhira mak ita nian oan halo visit aba cek-up nihan ou ba tratamentu nihan?

   Menus husi fulan 6 liuba: ☐

   Entre fulan 6 to fulan 12 liuba: ☐

   Entre fulan 12 to fulan 24: ☐

   Liu fulan 24: ☐

   Nunka: ☐

3. Karik ita nian oan halo visita ba dentist menus husi fulan 24 liuba, iha visita ikus nian simu tratamentu nihan ka lae?

   Sim: ☐

   Lae: ☐

   (Karik simu, favor kontinua ba pergunta no 4 ho 5. Karik lae, hakat ba Part?)

4. Rasaun saida ita nia oan halo visita ikus ba dentista (Favoe, bele tik liu resposta ida):

   Nihan moras: ☐

   Nihan koak: ☐

   Iran/gingiva ra'an: ☐

   Nihan monu: ☐

   Trauma: ☐

   Nihan falsu: ☐

   Cek-up: ☐

   Seluk: ☐

   (Karik seluk, favor espesifika ----------)

5. Tratamentu saida nak ita nian oan simu? (Favor, bele tik liu resposta ida)

   Ezaminasaun no simu reseita: ☐

   Hamos no scaling nihan: ☐

   Fokit nihan: ☐

   Taka nihan: ☐

   Halo nihan falsu: ☐

Seluk: ☐

(Karik seluk, favor especifika)

D. Impaktu Ba Saude Oral *(Impact of Oralhealth)*

1. Durante fulan 12 iku ne'e, ita nian oan sofre moras nihan dala hira?

   Bebeik hela deit ☐

   Bebebik ☐

   Dalaruma ☐

   Dalartuma deit ☐

   Nunka durante fulan 12 ikus ne'e ☐

   La hatene ☐

2. Durante fulan 12 liuba, dalahira mak ita nian oan senti la kontenti ho nia nihan ou nian ibun?

   Bebeik hela deit ☐

   Bebeik ☐

   Dalaruma ☐

   Dalaruma deit ☐

   Nunka durante fulan 12 ikus ne'e ☐

   La hatene ☐

3. Dalahira mak ita nian oan lakoi han hahan balu tamba problema ho ninia nihan durante fulan 12 ikus ne'e?

   Bebeik hela deit ☐

   Bebeik ☐

   Dalaruma ☐

   Dalaruma deit ☐

   Nunka (durante fulan 12 ikus ne'e) ☐

   La hatene ☐

Obrigado ba ita nian kontribusaun. Favor fo tempu itoan cek fali resposta nebe ita fo ona no favor fo fila Kuestionario ne'e ba ita nia oan nian professor/a.

Karik iha komentarios ruma, bele hakerek iha espasu karik ne'e:

Appendix 11

Form 1

CHILD EXAMINATION FORM

Examiner Code : . . . . . .
Recorder Code : . . . . . .
Child ID : . . . . . .
Date : . . . . . .

Name : ..... Sex :..... Date of birth ...../...../19....

School: .....District: ..... Province: .....

Dentition status

	7	6	5	4	3	2	1
UPPER RIGHT							
UPPER LEFT							
LOWER LEFT							
LOWER RIGHT							

Status	Sound	Decayed	Filling with decay	Filling no decay	Missing as a result of caries	Missing, any other reason	Fissure sealant	Trauma	Unerupted tooth	Not recorded
Primary tooth	A	B	C	D	E	-	-	T	-	-
Permanent tooth	0	1	2	3	4	5	6	7	U	X

Periodontal Index

Bleeding index

0: No bleeding
1: Bleeding
Y: Cannot be assessed

16 11 26
46 31 36

Calculus index

0: No calculus
1: Calculus
Y: Cannot be assessed

16 11 26
46 31 36

CLINICAL EXAMINATION (GENERAL ADULT)

Name: ---------- Age----------

Date: ------/------/----------Male☐ Female ☐

Location code----------
Subject ID----------
Examiner ID----------

Repeat exam ☐

Oral mucosa

Conditions	Location	
0: Normal		
1: Cancer	Lips	☐☐☐
2: Leukoplakia	Buccal mucosa	☐☐☐
3: Lichen planus	Mouth floor	☐☐☐
4: Ulceration	Tongue	☐☐☐
5: ANUG	Hard/soft palate	☐☐☐
6: Candidiasis	Alveolar ridges/gingiva	☐☐☐
7: Abscess		
8: Other		

Edentulism

Upper ☐
Lower ☐

Denture

	U	L
Full	☐	☐
Partial	☐	☐
Fixed	☐	☐

Dentition status recorded every tooth, subjects 45+ yrs are recorded both crown and root conditions.

		17	16	15	14	13	12	11	21	22	23	24	25	26	27
upper	crown														
	root														
lower	root														
	crown														
		47	46	45	44	43	42	41	31	32	33	34	35	36	37

crown	sound	decayed	filled with decay	filled no decay	missing	unsatisfactory filling	fissure sealant	crown	trauma	not recorded
	0	1	2	3	4	5	6	7	8	9
root	sound	decayed	filled with decay	filled no decay	-	unsatisfactory filling	-	implant	-	not recorded

Qualified for periodontal probing: yes ☐ no ☐ (ask for bleeding, rheumatic heart disorder and transplants)

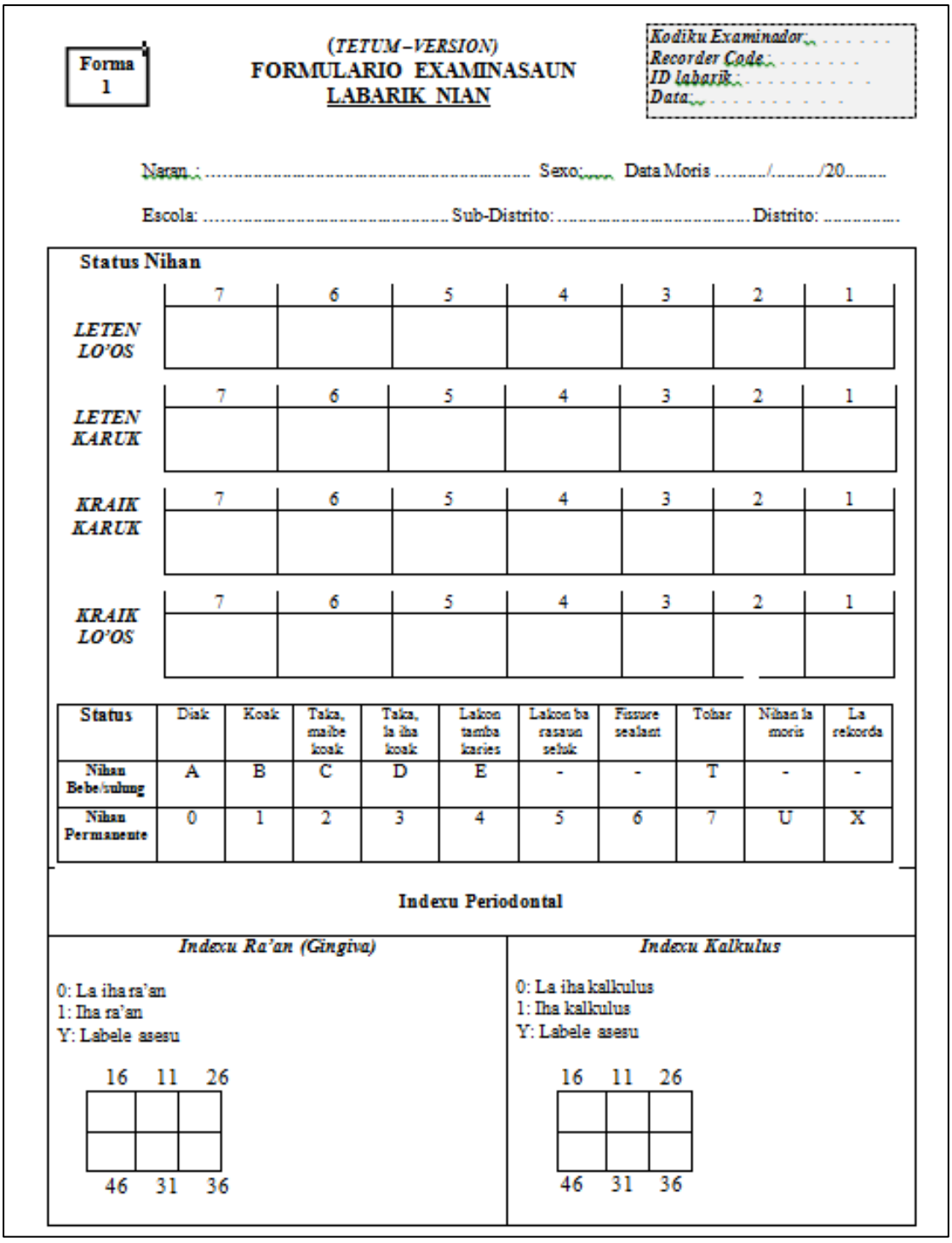
CPI score

Sextant	17 -------- 14		13-------- 23	24 -------- 27	
Index teeth	17	16	11	26	27
Index teeth	47	46	31	36	37
Sextant	47 -------- 44		33 -------- 43	34 --------- 37	

Recorded using lightweight CPI probe with a 0.5 mm-ball tip, with a black band between 3.5 and 5.5 mm and rings at 8.5 and 11.5 mm from the tip

0: Healthy.
1: Bleeding observed, directly or by using a mouth mirror, after probing
2: Calculus detected during probing, but all of the black band on the probe is visible
3: Pocket 4-5 mm (gingival margin within the black band on the probe)
4: Pocket 6 mm or more (black band on the probe not visible)
X: Excluded sextant (less than two teeth present)

Appendix 12



Forma 1

(TETUM–VERSION)

FORMULARIO EXAMINASAUN

LABARIK NIAN

Kodiku Examinador: . . . . . .
Recorder Code: . . . . . .
ID labarik: . . . . . .
Data: . . . . . .

Naran.: ..... Sexo:.... Data Moris ...../...../20.....

Escola: ..... Sub-Distrito: ..... Distrito: .....

Status Nihan

	7	6	5	4	3	2	1
LETEN LO'OS							
LETEN KARUK							
KRAIK KARUK							
KRAIK LO'OS							

Status	Diak	Koak	Taka, maibe koak	Taka, la iha koak	Lakon tamba karies	Lakon ba rasaun seluk	Fissure sealant	Tohar	Nihan la moris	La rekorda
Nihan Bebe/sulung	A	B	C	D	E	-	-	T	-	-
Nihan Permanente	0	1	2	3	4	5	6	7	U	X

Indexu Periodontal

Indexu Ra'an (Gingiva)

0: La iha ra'an
1: Iha ra'an
Y: Labele asesu

16 11 26
46 31 36

Indexu Kalkulus

0: La iha kalkulus
1: Iha kalkulus
Y: Labele asesu

16 11 26
46 31 36

EXAMINASAUN KLINIKA (ADULTO GERAL)

Naran: ---------- Tinan. ----------

Data: ------/------/----------Mane ☐ Feto ☐

Kodiku fatin ----------
ID subjeto----------
ID examinador----------
Recorder ID----------

Repete examinasaun ☐

Mukosa ibun/oral

Conditions: 0: Normal; 1: kanker; 2: Leukoplakia; 3: Lichen planus; 4: Ulceration; 5: ANUG; 6: Kandidiasis; 7: Abcess; 8: Seluk-seluk

Locations: Lips/ibun kulit ☐☐☐; Mukosa bukal ☐☐☐; Dasar mulut/Mouth floor ☐☐☐; Nanal ☐☐☐; Palatum toos/mamar ☐☐☐; Alveolar ridges/gingiva ☐☐☐

Edentulism: Leten ☐; Kraik ☐

Denture: U L; Full ☐☐; Partial ☐☐; Fixu ☐☐

Status Nihan: rekorda kada nihan, subjetos tinan 45+ presiza recorda kondisaun koroa no nihan abut.

		17	16	15	14	13	12	11	21	22	23	24	25	26	27
leten	**koroa**														
	abut														
kraik	**koroa**														
	abut														
		47	**46**	**45**	**44**	**43**	**42**	**41**	**31**	**32**	**33**	**34**	**35**	**36**	**37**

Koroa	Disk	Kosk	Taka, maibe kosk	taka,laiha kosk	Lakon	Taka la satisfas	fissure sealant	Koroa	Tohar	La rekorda
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Abut	Disk	Kosk	Taka maibe kosk	Taka,laiha kosk	-	Taka la satisfas	-	Implant	-	La rekorda

Kualifikadu ba periodontal probing: sim ☐ lae ☐ (husu konaba hemoragia, rematismo fuan (rheumatic heart disorder) no transplantasaun sira)

Skore CPI

Sextant	17 -------- 14		13------- 23	24 -------- 27	
Indexu nihan	17	16	11	26	27
Indexu nihan	47	46	31	36	37
Sextant	47 -------- 44		33 -------- 43	34 ---------- 37	

Recorded using lightweight CPI probe with a 0.5 mm-ball tip, with a black band between 3.5 and 5.5 mm and rings at 8.5 and 11.5 mm from the tip.

Six sextants are assessed for gingival bleeding, calculus and periodontal pockets.

0: Saudavel/ diak.
1: Hare ra'an, direitamente ou uza kaca mulut, ou hafoin probing
2: Deteta kalkulus dursnte probing, maibe pontu metan (the black band) husi probe sei vesibel (hare hetan).
3: Pocket 4-5 mm (pontu metan (black band) husi probe hatur iha gingiva margin))
4: Pocket 6 mm ou liu 6 mm (black band iha probe la visible/ hare lahetan)
X: Sextant ignora tiha (Excluded sextant) (kuandu iha ou menus nihan rua deit mak presenca).

Appendix 13

Participant Consent Form

(Confidential)

"The Local Survey of Children Oral Health Status in the District of Dili, Timor-Leste"

I, (name) ....., the undersigned, have read the description of this study.

I hereby consent to allow my child/children to participate in the research study called the Local Survey of Oral Health Status in the District of Dili, Timor-Leste.

I understand that although the purpose of the study is to improve dental care, my child's participation may not be of any direct benefit to him/her.

I understand that when the results of this study are published no names will be used and no individuals identified.

I understand that I am free to withdraw my child from the study at any time.

Signed ..... Date
..... /...../.....

For any other query please contact (Chief Investigator):

In Tasmania, Australia:

Dr Lucio Frederico Babo Soares
Ph:
Email:
Home Address: -Tasmania, Australia.

In Dili, Timor-Leste:

Enderesu uma: , Dili, Timor-Leste

Email:
Ph:

Appendix 14

Participant consent form (Tetum Version)

(Konfidensial)

Formulario Konsente Ba Participantes Sira

"Survey Lokal Saude lbun Ho Nihan ba Labarik Sira Iha Distritu Dili, Timor-Leste"

(The Local Survey of Children Oral Health Status in the District of Dili, Timor-Leste)

Hau, (naran) ....., nebe asina iha kraik ne'e, le'e ona deskripsaun husi estudo ida ne'e.

Tamba ne'e, hau konsente hodi fo licenca ba hau nian oan atu participa iha peskiza nebe hanaran Survey Lokal Ba Profile Saude lbun Ho Nihan Labarik Sira Nian Iha Distritu Dili, Timor-Leste.

Hau kumpriende katak participasaun hau nia oan nian iha estudo ne'e sei la fo benefisio direitamente ba nia maske objetivu husi estudo ne'e propoin atu hasae kuidadus saude dentaria.

Hau kumpriende katak wainhira resultadu husi peskiza ne'e ramata, hau nia oan nian naran sei la publika no sei la identefika individualmente.

Hau kumpriende katak hau iha liberdade total atu hapara hau nia oan husi estudo ne'e iha kualker momentu.

Asinatura ..... Data

...../ /.....

Karik iha duvidas ruma bele kontaktu peskizador tuir detailas iha kraik ne'e:

Iha Tasmania, Australia:

Dr Lucio Frederico Babo Soares
Ph:
Email:
Enderesu uma: -Tasmania, Australia.

Iha Dili, Timor-Leste:

Enderesu uma: Dili, Timor-Leste
Email:
Ph:

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Babo Soares, L. F., Allen, P.,Bettiol, S., Crocombe, L., 2016. The association of socioeconomic status and dental caries experience in children in Dili, Timor-Leste, Asia Pacific journal of public health, 2016, 28(7), 620-628

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Babo Soares, L., Bettiol, S., Dalla-Fontana, I. J., Allen, P., Crocombe L. 2016. Opportunities in oral health policy for Timor-Leste, WHO South-East Asia journal of public health, 5(2), 164-173.